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FACTORY

MANAGEMENT AND MAINTENANCE

MAY 1948

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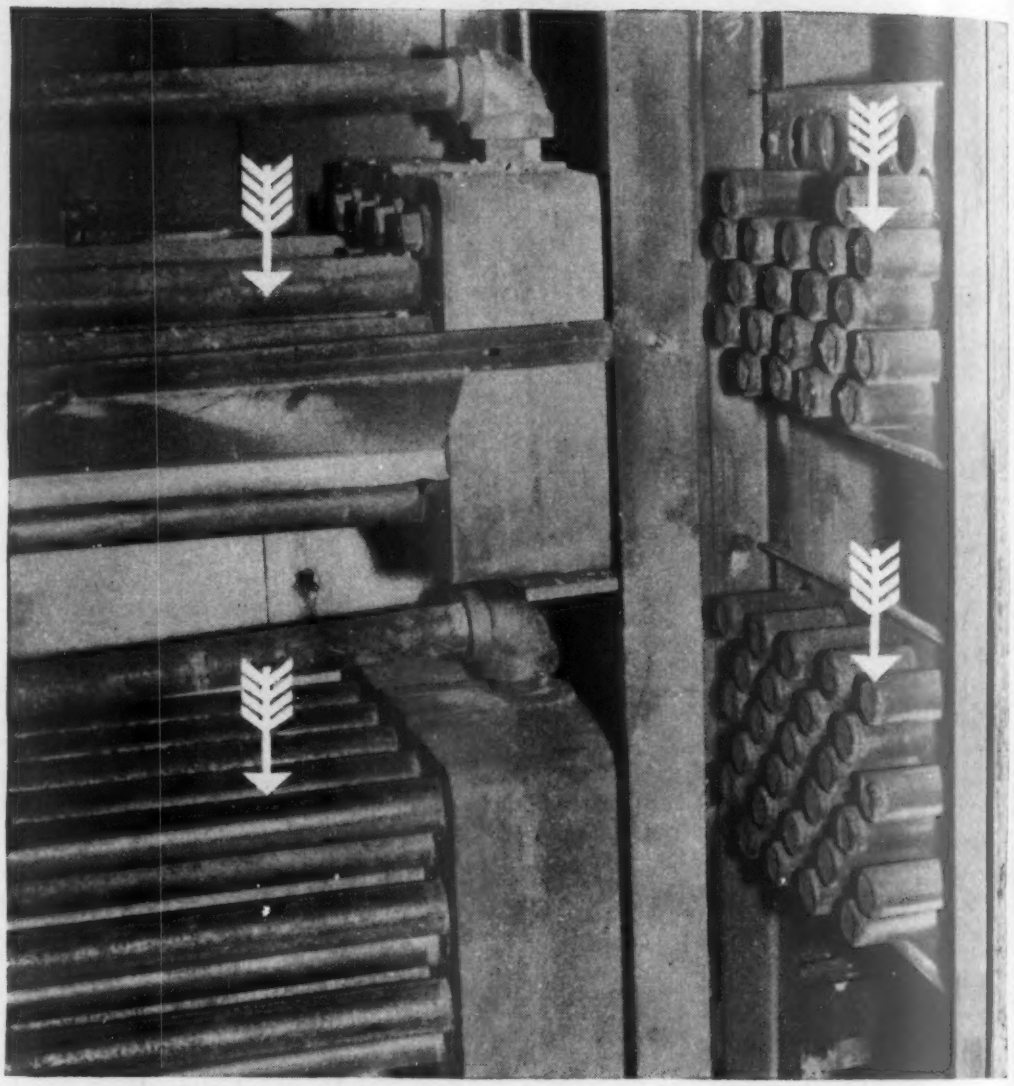
A McGRAW-HILL PUBLICATION

Byers Wrought Iron Pipe

doubles up here—to combat corrosion

This drier has the job of dehydrating processed materials, as the last step in manufacture. A double-tube design is used, with a ⅜-inch pipe centered inside a 1¼-inch pipe, and secured in a manifold. Steam is passed through the inner pipe, and returns through the outer one. Air, blown through the banks and then over the processed materials, does the drying.

Every engineer will recognize the highly corrosive character of these conditions, and the necessity of using a durable material. Byers Wrought Iron pipe, which has repeatedly demonstrated its superior endurance in all varieties of heat exchangers, was used for the job.



PROOF FROM THE RECORDS

The soundness of this choice is verified by a glance at the record. Byers Wrought Iron pipe has been used in double-tube atmospheric, and shell-and-tube condensers, in economizers, and in pre-heaters, and has been remarkably successful in eliminating excessive repairs and replacements. To cite one typical example—the inner pipes of a double-pipe condenser, made of a low-first-cost material, developed leaks in only one year. Replacements were made with Byers Wrought Iron pipe. At last reports it had served 11 years with no trouble, and no sign that the end of its usefulness was anywhere in sight.

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CORROSION COSTS YOU MORE THAN WROUGHT IRON

FACTORY

MANAGEMENT and MAINTENANCE

MAY, 1948

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Brushes Become Bullets...

TO SIMPLIFY CONDENSER TUBE CLEANING

THIS honeycomb of 5681 copper alloy tubes, each 20 ft. long, is the inside of a steam condenser in the Connellsville Power Station of the West Penn Power Co. With more than thirty-five million gallons of raw river water passing through these condenser tubes daily, the deposits of mud and muck, bound together with algae growth, create a major maintenance problem.

The most effective method of cleaning these tubes previously found consisted of "shooting" metal scraper plugs through the tubes by water pressure. While this method removed most of the deposit, the scrapers scratched the tube surfaces, which allowed new deposits to form even more rapidly. Engineers had observed that new tubes remained clean longer than tubes that had been cleaned by conventional methods. This led to the conclusion that a method of cleaning that would leave the tube surfaces in new condition would be beneficial.

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AN EXCLUSIVE REPORT TO FACTORY'S READERS

Is Russian Industry Ready for War?

Acme

ROBERT MAGIDOFF

McGRAW-HILL WORLD NEWS CORRESPONDENT

Accused as a spy . . . suddenly expelled from Russia on April 15 because he had been asked to report on Soviet experience with underground plants in World War II (see FACTORY, March, 1948) . . . the correspondent for McGraw-Hill World News in Moscow returned to the United States on April 22 . . . is now able to make an uncensored, first-hand report on Russian industry

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FALSE CHARGES OF ESPIONAGE BRING MAGIDOFF HOME

U. S. Correspondent Accused as ... Moscow

Izvestia Attributes Charge to U. S. Gi...
Who Once Was Embassy Aid.

Moscow, April 15 (A. P.).—Izvestia, the Soviet ment newspaper, today published a letter ac American correspondent, Robert Magidoff, of an American espionage service.

Magidoff said he had been in- formed by the Soviet Press De- partment that his further work here is impossible and his further residence undesirable. He plans to leave within two or three days.

Magidoff represented the Na- tional Broadcasting Company, the Exchange Telegraph Company, the London and the McGraw-Hill Pub- lishing Company of New York. He was once on the Associated Press staff here.

The accusations against him were attributed to Cecilia Nelson, his former secretary. A girl from Michigan, she had also been employed as a secretary at the United States Embassy here.

[In Washington today the State Department said that Miss Nelson was hired by the Moscow Embassy during the ... on her were

source." For exam... in replying on Ja... request for infor... "It will be a ge... material appea... ence to Mosco... ascribe it to m... pear this info... from the pub... "When I re... the woman ... to me . . . hatching ... doff's co... data abo... doubted ... . . . Al... the co... brou... mal... Mo... co...

YORK

APRIL 16, 1948

...rce Russia Expels ... in U.S. Reporter ...5-0 Called a Spy ...ows Woman Secretary ...lows Makes Accusation

IS RUSSIAN INDUSTRY READY FOR WAR? Magidoff says no, not today. But consumer goods are going by the board while Russia concentrates on heavy industry. That means she is building war *potential.* If planning goals are met, Russian industry could be ready for war in 1960. To date, goals are being met or closely approached. *But the industry now being built could also be a peacetime productive giant. Stalin, not the Russian people, will decide*

DO THE RUSSIANS have the industrial machine to back up their power plays in Europe?

How does Soviet industry stack up against U. S. industrial might?

Just how strong *is* Russian industry?

From the information and impressions I have gathered during my 12 years in Soviet Russia, and from data made available to me by FACTORY, the following conclusions about Russian industry seem to me to be justified:

1. Over-all, today, the United States is outpacing Russia 4 to 1 in industrial production.

2. But Russia is producing several times the volume of war weapons that the U. S. is turning out. For example, the Soviets, according to U. S. Army

TO WRITE FREELY AGAIN

ROBERT MAGIDOFF has just returned to the United States after 12 years as an American correspondent in Moscow. He left because the official government newspaper *Izvestia* accused him of espionage against the Soviet Union. Routine questionnaires on underground plants, atomic energy, and air transport submitted by McGraw-Hill World News to all of its overseas correspondents, were the apparent basis for the charge, which was first made to *Izvestia* by Magidoff's American-born secretary.

Proof that the charge was unfounded is provided by the Russians themselves: *The day Magidoff left, the Russian Press Department accredited his assistant, Andrew Steiger, an American citizen, as the new correspondent for McGraw-Hill.*

That was April 15.

Ten days later, Magidoff was back in the United States, preparing this special analysis of Russia's war potential.

Born in Russia, Magidoff was educated in the United States, became an American citizen at an early age. His intimate knowledge of the Russian language has given him a sharp advantage over most American correspondents. He was the only English-and-Russian speaking reporter to accompany Eric Johnston, then president of the United States Chamber of Commerce, on the most extensive survey of Russian industry ever made by a foreign visitor.

Magidoff knew Russian industry before the war, too. Knew it so well, in fact, that in 1941 he forecast accurately the Russians' ability to withstand the Nazi onslaught. That was at a time when virtually every "informed observer" was predicting that all Russia would be under the Nazi heel in 6 weeks to a year, at most.

Now, free from censorship—and from the danger of personal reprisal—Magidoff gives to FACTORY's readers his first exclusive published report on the present state of Russian industry.

The editors of FACTORY and the McGraw-Hill World News Bureau feel confident that no man outside of the inner circle of the Politburo is in a better position to know the real facts about Soviet industry today.

testimony, are producing twelve times as many combat aircraft as we are building.

3. And, more important, they are sacrificing their civilian economy to a large extent to multiply munitions-producing capacity.

4. There is some evidence that in sacrificing consumer industries—and the people's living standards—Stalin is creating a weakness in the Soviet economy. It would be a fatal error to accept Russia's low standard of living as indicating a comparably low war potential. Russia's war potential is very much greater than her low standard of living might lead Americans to believe.

These conclusions, however, by no means tell the whole story. We produced 85,000,000 tons of steel last year while the Russians turned out 18,000,000. We generated more than 250,000,000,000 kilowatt-hours of electric power—five times as much as the Soviets.

But, the Russians have geographic leverage on European affairs, an army of more than 4,000,000 men, and possibly as much as one-third of her limited industry is turning out munitions. Moreover, Russia is concentrating on building plants and equipment that will enable her to increase weapons production several-fold before 1960.

1940 Is Key to Present Position

To get an over-all view of how the Russian, U. S., and Western European industrial machines compare, you have to look back at their positions in 1940.

For, although Russia stands second only to the United States in industrial production today, her factory output is further behind ours now than it was in 1939, when our industrial machine was idling along.

In 1940, Russia produced about one-third of what the Western European nations did. And, altogether, the countries of Western Europe produced almost as much as the United States did.

Russia's own reports on her 1947 industrial recovery—as proclaimed by Molotov—show that her production has barely regained its 1940 level.

Western Europe's output is off one-fourth, or slightly more, from its pre-war level.

And U. S. production is almost half again above what it was in 1940.

To put it another way: Today we are producing twice what Western Europe is—and four times what Russia is. Our 4-to-1 edge over Russia goes up to 6 to 1 if you consider populations. There is six times as much factory output for each American as there is for each Russian.

But there is always the question of how much goes to war. Even during World War II, when we were producing easily six times as much as were the Russians, their munitions production was estimated, by U. S. Army economists, at perhaps one-third of ours. Apparently the Russians were getting twice as much military yardage out of what industry they had as we were. And, in the same way, the Russians are outproducing us in munitions today.

To Russia's own industry, of course, must be added that of the satellites. Czechoslovakia's Skoda Works, with its production of tanks, artillery, armor, and munitions, has been a diplomatic football for decades. But even with Skoda, the Ploesti oil wells and refineries, and the Silesian coal mines, Eastern Europe's contribution will be small.

True, the oil is vital for modern war. But, the entire industry of the Eastern European countries adds up to less than one-third of Russia's, although the area has a population two-thirds the size of Russia's.

Marshall Plan Is Significant Factor

At most, Eastern Europe's industry modifies our current industrial superiority over Russia from 4 to 1 to 3 to 1. But the qualification counts for less than does what happens in Russia itself. It counts still less than does what might happen in Western Europe. If

BOX SCORE OF INDUSTRIAL PRODUCTION

		STEEL (Millions of Tons)	COAL (Millions of Tons)	GRAINS (Millions of Tons)	ELECTRIC POWER (Billions of Kilowatt Hours)	TEXTILES (Billions of Yards)	POPULATION (Millions)
U.S.A.	1940	67	503	121	145	10.5	132
	1947	85	658	151	255	11.5	145
	1950	90	650	165	285	12.0	151
WESTERN EUROPE	1940	60	607	71	140	10.0	261
	1947	34	483	54	170	6.3	270
	1951	61	642	72	222	10.1	290
U.S.S.R.	1940	20	183	118	48	4.1	193
	1947	18	196	100	54	2.6	197
	1950	28	275	126	82	4.8	205
EASTERN EUROPE	1940	5	90	75	17	1.8	121
	1947	FIGURES NOT AVAILABLE					
	1950						

RUSSIA'S BASIC INDUSTRIES have returned from wartime lows to 1940 levels. Comparative Russian-U. S. position in event Western Europe falls can be determined by addition. But Magidoff believes this unlikely if Marshall Plan is successful

the Marshall Plan nations fully recover their industrial health, they will far overshadow Russia and her satellites, production-wise.

Russia, however, intends to shift the balance of industrial power to her side of the Iron Curtain.

To understand how, you must take a look at the Five-Year Plans.

Russian industry in the last days of the Czars was small. What there was of it, was completely disrupted by World War I and the Revolution. It was not until 1928 that her production regained its 1913 level. But in 1928 it was a balanced industrial machine.

The first Five-Year Plan, started in 1928, built up oil, coal, steel, power—basic, heavy industries. But it sacrificed light industry—shoes, textiles, foods.

The second Five-Year Plan, finished in 1937, boosted production in both types of industries. Heavy industries were built up and state-operated factories were set up to replace the village industries in making consumer goods. The gains in light industries, however, merely recouped the losses under the first plan. So Russia's light industries in the late '30s were producing just about what they had produced in 1913—a quarter of a century before. Her heavy industries showed spectacular gains, of course, so her economy was lopsided.

The approach of World War II quickly shifted emphasis in the third Five-Year Plan to munitions—and to the industries with which to make them. Result: More unbalance.

The war itself devastated industry in Western Russia, which had produced well over one-half of Russia's total output. So the Russians shifted hundreds of heavy industry plants—and built many new ones—in the Urals.

All this meant still more unbalance. At the start of the fourth Five-Year Plan, in 1946, Soviet heavy industries were close to pre-war production levels, and in a few cases were above. But her light industries were hard put even to clothe the troops. Their production was from 55 to 90 per cent below 1940 levels—at new lows, well below even 1913 output. Of the Soviet's total industrial capacity, well over two-thirds was in heavy industry.

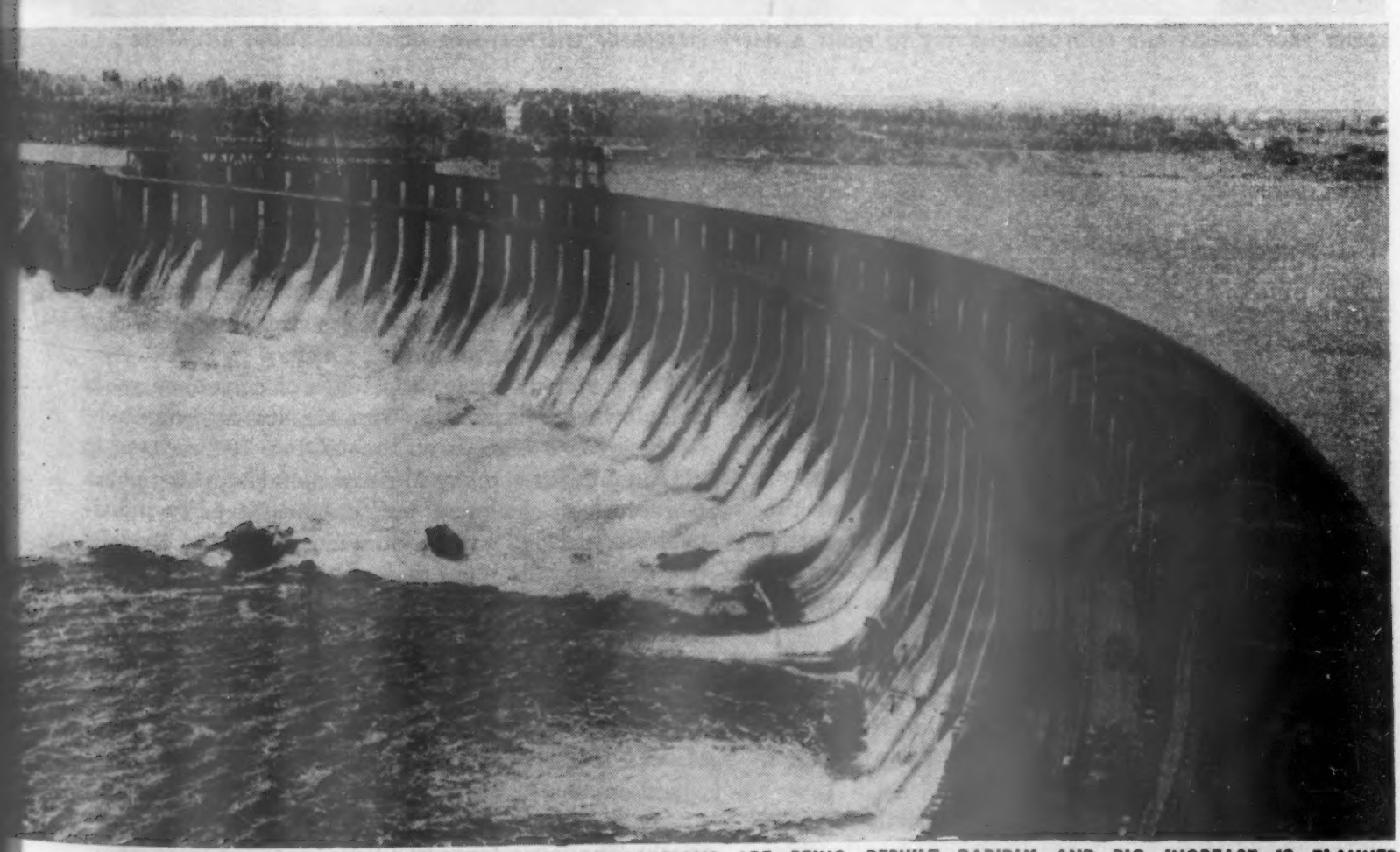
To offset this unbalance to some extent, the fourth Five-Year Plan, although scheduled to raise production from the heavy industries to 60 per cent above 1940, calls for the sharpest gains in the much-mutilated light industries.

Thus the steel goal of 25,000,000 metric tons runs 75 per cent over 1945 output and 40 per cent above pre-war. Coal, at 250,000,000 metric tons, is to be two-thirds higher than in the last war year and one-half above pre-war. Sharpest jumps are called for in metal products—autos and trucks to go from less than 150,000 in 1940 to 500,000 in 1950, and output of "metallurgical equipment" is to be increased from 28,000 metric tons in 1940 to 103,000 in 1950.

By comparison, the 1950 cotton textile goal is only 16 per cent above 1940—but 190 per cent higher than

Photographs of Russian industry used in this article are from Sovfoto

STRONG FACES REFLECT BOTH HARD LIFE AND DETERMINATION OF WORKERS IN RUSSIA'S NEW STEEL INDUSTRY IN URALS



NAZI-DESTROYED DAMS AND HYDRO-ELECTRIC INSTALLATIONS ARE BEING REBUILT RAPIDLY AND BIG INCREASE IS PLANNED

SOVIET PROPAGANDA AND PHOTOGRAPHS TRY TO PAINT A HAPPY PICTURE OF THE POST-WAR CONSUMER GOODS SITUATION . . .

1945. Scheduled shoe production for 1950 would exceed 1940 by 4 per cent, but top 1945 by 300 per cent. And so on for woolens, hosiery, and other consumer goods.

This unbalance will remain in the Soviet Union for a long time to come. It is both a strength and a weakness. It is the foundation for the Communists' war machine, but it contributes powerfully to the basic weakness in the whole Communistic state—low labor productivity.

Correction Means Dropping War Aims

Soviet leaders are aware of the urgency of this problem and are taking half-measures to correct it somewhat. But they cannot go the whole way, because they do not want to jeopardize the over-all strategy of Russia's industrialization.

Pravda, the official Party newspaper, complains: "A number of ministries and managerial staffs of many trusts and plants apparently underestimate the political and economic significance of the production of goods needed by the people."

The heavy industry plants, built primarily for war, are supposed to turn out consumer goods as a sideline. The Stalin Auto Works in Moscow, for example, is supposed to turn out, on the side, consumer necessities such as spoons, forks, cups, shovels, and hammers. But, says *Pravda,* when someone must be sent to the plant's truck garden, a worker is taken from the consumer goods shops. And, when difficulties arise with electric power, the switches in the consumer goods shops are pulled first.

It is a vicious circle. Shortages of consumer goods pull down labor morale. Workers are discontented—so turnover is high. It was more than 100 per cent in nine months in one key Moscow metal-working plant. Absenteeism, slackness, and downright petty industrial theft follow, and are so widespread that the official press assails them daily. High turnover and low productivity, in turn, keep production low. That keeps workers unhappy.

To break the circle, the Kremlin last year dictated price and monetary reforms, chiefly to give workers a larger share of consumer goods. (FACTORY, March, 1948). But the reforms have by no means wiped out the problem.

Russia's workers are her main weakness, industrially. The labor force had been restored *in numbers*

. . . BUT MAGIDOFF REPORTS THAT CONSUMERS ARE GETTING VERY SHORT SHRIFT AS RUSSIA EXPANDS HER HEAVY INDUSTRIES

by 1947—but that is by no means the whole story. A great number of Russia's skilled workers were killed during the war. Older men, women, and boys have been brought into the factories to fill the ranks. But they have not been able to perform at anything like the high level of efficiency required for industry to regain its basic strength and vitality.

As a further remedy for this problem, Russia has set up trade schools for both boys and girls, particularly to train workers for the coal and metallurgical industries and for Russia's overburdened transport system. There is no question of volition; the youngsters are drafted for attendance at these schools. Possibly 2,000,000 have been drafted to date, but several more years will have to pass before they become an important factor on the industrial scene.

With all this, plus the devastation of the war and general war weariness, the stifling restrictions and ukases have acted to prevent Russian labor productivity from regaining pre-war levels.

One measure of Russia's living standard — and a heavy handicap to her industry — is housing.

Some 25,000,000 Russians, one-fourth of the population in the areas the Nazis occupied, were left homeless after the invasion. But Russia's entire housing program under the fourth Five-Year Plan calls for building only 72,000,000 square meters of living space. In U.S. terms, the five-year goal just about equals our 1948 target of a million new homes. It probably won't even match the increase in the Soviet population in the period. And it is likely, too, that only by statistical "miracles" will the housing plan come close to its goal. Moscow building repairs fell short of the 1947 goal by 70 per cent. Industries producing building materials are behind schedule — and industrial plants and public buildings get priority on what materials are available. The result of all this is that the Soviet population is still so crowded — as far as housing is concerned — that the picture is completely beyond the comprehension of most Americans.

Atomic Program Handicapped

Russia's unbalanced industry—which is the backbone of her military machine—is even a handicap when it comes to producing atomic age weapons.

Our light, high-precision industries made possible the production of the atom bomb here within five years. Russia's lack of them adds years to her bomb

production schedule. She must first build the industries and train labor that can make instruments, high-vacuum pumps, and delicate control mechanisms before she can build the plants to build the bombs.

However, the Kremlin's unlimited control over Russia's population and resources allows it to marshal the necessary manpower and material for any urgent project, even if it is done at the expense of progress in other fields. *In order to forestall possible surprises, this vital fact should be kept constantly in mind.*

Where Soviet Industry Is Weak—and Strong

There are specific weaknesses in the Russian industrial armor. They include:

Timber. The 1947 output was behind 1938's, even though the Russians have transplanted all lumber mills in Eastern Germany, many from the satellites.

Oil. Output sagged from 31,200,000 metric tons pre-war to 20,500,000 in 1945. In 1947 it was only 27,300,000 tons. Hitler's legions were stopped short of the Caucasian fields around Baku, but those wells show signs of playing out. For, while oil production in Eastern Russia is rising, the Soviet 1950 oil goal is only 12 per cent above 1940—the smallest of the target increases in basic industry.

Aluminum. War destroyed Western Russia's main plants. In 1944 she imported 120,000 tons from the U. S. New plants have been built, but goals call for only 170,000 tons annual output, which may be supplemented by works moved in from Eastern Germany.

The government claims that plans for industrial production were over-filled by 3.6 per cent last year. It says that, of 29 industrial ministries, 22 over-filled the plan, one just reached the goal, and only six fell short.

Even if we accept these claims at their face value, we must emphasize that *the* key industry, iron and steel, fell 7 per cent behind the goal set for it—a failure that cannot but have an adverse effect on progress in practically all other industrial fields. We also must bear in mind that the steel goal (for 1950) is only 30 per cent of U. S. production.

But Soviet industry has strong points, too:

1. A recovery in coal production to well above pre-war levels. That has allowed reductions in imports from Poland's rich mines—even though the Donbas mines, which produced half of Russia's coal in the '30s and were destroyed during the war, are back only to 75 per cent of 1940.

2. The building up of huge new industrial centers in Russia's interior—beyond reach, the Russians hope, of American planes carrying atomic bombs. More than half of her current industrial investment is now going into these new centers, many beyond the Urals.

Much of this vast decentralization movement is already complete. Some 1300 plants and 15,000,000 workers and their families were shifted eastward during the war. Most of them have remained there. By 1950, half of all Russia's steel and coal will come from the East—where only one-third did before the war. Shifts in other industries are comparable.

Adding to Russian strength are the satellites and reparations, and war booty from occupied Europe (particularly Eastern Germany), Manchuria, and Korea.

One measure of this strength, and a formidable threat to Europe in case of war, is Russian aircraft production.

By testimony of the U. S. Air Force, Russian aircraft production is twelve times ours. Which means that Russia is producing from 6000 to 12,000 military aircraft a year and possibly even more, including some 500 long-range four-motor bombers (many of them modeled after B-29's forced down in Russia during the war), and up to 2000 jet fighters.

Figures on weapons production are closely guarded secrets, of course. But the published figures on the Soviet budget, which includes all industrial projects, show that something over half of all Russia's industrial effort is devoted to arms or to building basic industry that can be converted to arms production.

Plan to Triple Output by 1960

Soviet goals for 1960—as announced by Stalin more than a year ago—show clearly the Russians' industrial aims. By 1960 Stalin plans virtually to double the hoped-for totals for 1950. If he succeeds, he will raise industrial output to three times what it is today.

Steel production, for instance, is slated to go from 18,000,000 metric tons to 60,000,000 in 1960. Coal output would be almost tripled from less than 200,000,000 to 500,000,000 metric tons.

But even then, Soviet industry will be almost as lopsided as it is now. The 1960 goals for most consumer goods are not even mentioned in the program. Where they are set, they remain at low levels.

How, then, will Soviet industry compare with ours and with Western Europe's—if the Soviets continue to boost their war potential through the years to 1960?

One side of the answer is brief. Even if the Russians fulfill their 1960 aims, their over-all output will fall far short of U. S. output. They will still be short of what our production is today—by 20 to 40 per cent in basic industry and by an incomparably wider margin in consumer goods.

The other part of the answer can only be written as history is made. Stalin's aim is to boost the heavy industries of Russia and her satellites to the 1940 level of Western Europe's.

★ ★ ★

There is no doubt in my mind that the United States should be prepared to meet any contingency. The facts brought forth in the foregoing article show that it can easily do so.

But it is also my conviction that although Russia is sparing no effort on its side to be prepared for any contingency, war between the U. S. A. and the Soviet Union is not inevitable.

Given absolute firmness, patience, and insistence on reciprocity, on the part of a geared-for-action United States—guided by a wise and farsighted foreign policy—the Russians, I believe, will stop short of war on any issue.

FACTORY
MANAGEMENT AND MAINTENANCE
L. C. MORROW, EDITOR

WHY THIS PUBLICATION WANTS INDUSTRIAL MOBILIZATION

FACTORY has been and is placing much emphasis on the need for industrial mobilization.

As far back as August of last year we published an article by General Brehon Somervell, now president of Koppers Company. He said, "Industry must act now to stop World War III." He told FACTORY's readers what industry could do, on its own initiative, to prevent another war. General Somervell's present post, plus his wartime experience as commander of the Service of Supply and the Army Service Forces, give him the qualifications necessary to speak with authority on this subject.

In its March issue of this year, under the title, "What We Are Doing About National Security," FACTORY told of the Industrial Mobilization Plan that has been developed under the National Security Act of 1947, which was passed in July, last year. This article gave industry at large the only comprehensive report of what is going on in Washington in regard to the part industry is to play if we have another war.

Following this over-all picture, we told in April (last month) how far the nation has progressed in the vital job of building a big enough stockpile of 67 strategic materials to carry on a major war.

In the same issue, in a special Industrial Mobilization Communique, FACTORY reported the opinions of Bernard M. Baruch and Charles E. Wilson (General Electric) on the need for industrial mobilization. It gave also the buying agencies throughout the United States, who will deal with industry in the purchase of equipment and supplies for the Army and Air Force.

The article on page 88 of this issue reports the condition of the airplane industry and the status of equipment now in possession of the armed forces.

Later articles will deal with other phases of industrial mobilization.

This series of articles, planned months ago, is particularly timely because of Russia's tactics in connection with Czechoslovakia, Finland, and Germany. The articles were conceived in the interest of maintaining peace. There is no hysteria back of them. Publishing them is not warmongering.

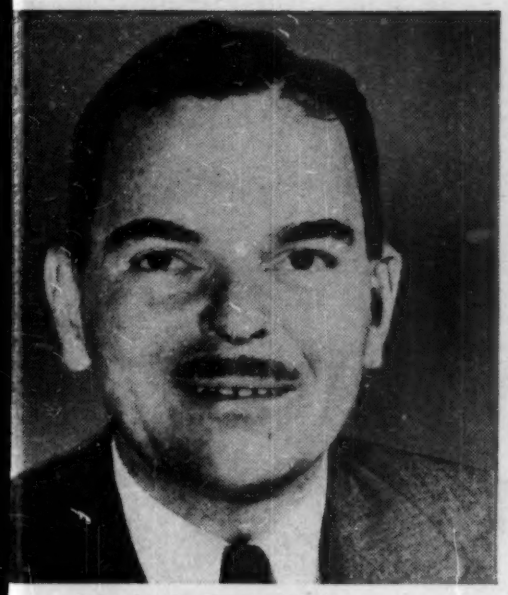
To FACTORY it seems but common sense to prevent a war by being ready to fight. This nation's wars have been won because its fighting forces have been backed up by its industries.

If there is another war, there will be no two years for industry to get ready. It will have to be ready when the first overt act takes place. Only good planning, backed by some actual production, can have it in readiness.

That is why FACTORY is so intent upon bringing about industrial mobilization.

L. C. Morrow

WHERE THE CANDIDATES STAND



THOMAS E. DEWEY
Governor of New York

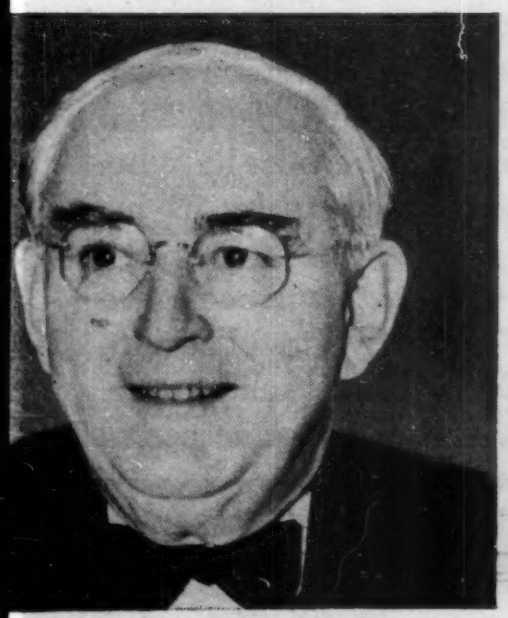
GEN. DOUGLAS MacARTHUR
Supreme Allied Commander in Japan

JOSEPH W. MARTIN, Jr.
Speaker of the House

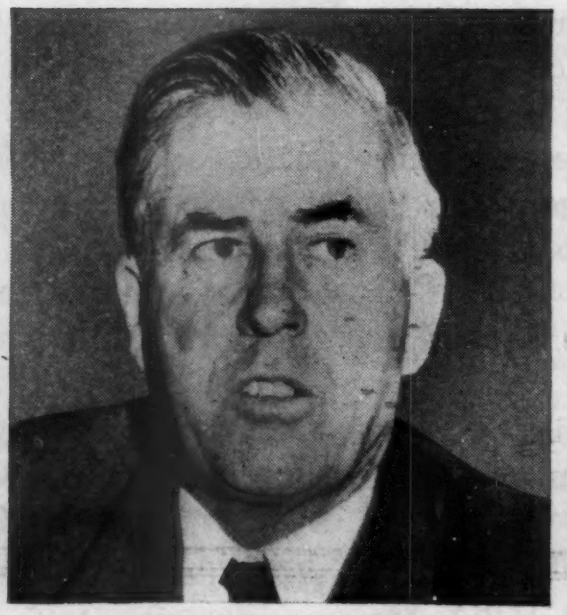
HAROLD E. STASSEN
Former Governor of Minnesota

ROBERT A. TAFT
Senator from Ohio

HARRY S. TRUMAN
President of the United States



ARTHUR H. VANDENBERG
Senator from Michigan



HENRY A. WALLACE
Former Vice President of the United States

EARL WARREN
Governor of California

ON MATTERS VITAL TO INDUSTRY

FACTORY presents the views of the nine leading contenders for the Republican, Democratic, and third-party Presidential nominations on these significant questions:

1 LABOR RELATIONS: Is the Labor Management Relations Act promoting or obstructing industrial peace? On the basis of experience to date, how should it be modified, if at all?

2 INDUSTRIAL WAGES: Is the present general level of industrial wages too high, too low, or about right? If too high or too low, what course should industry, labor, and government follow to bring about corrections?

3 WORKER SECURITY: How much further should industry and government go in providing worker security?

4 TAXES: What changes, if any, should be made in our corporate tax structure?

5 GOVERNMENT CONTROLS: Under what circumstances should the government control the prices and allocation of industrial materials? Of consumer goods?

6 GOVERNMENT REGULATION OF INDUSTRY: To what limits may government properly go in its regulation of private industry? Under what circumstances, if any, is government justified in either "taking over" or "competing with" private enterprise?

7 INFLATION: What measures should government, industry, and organized labor take now to combat inflation?

8 COMMUNISM: What should be the policy of industry, labor, and government toward Communists in the United States?

RESUMES of the candidates' views—presented on the pages that follow—were for the most part prepared by members of the staff of FACTORY and the McGraw-Hill Washington Bureau.

Assistance of the candidates and their campaign staffs was solicited. Mr. Wallace responded with an exclusive statement in answer to each question. Governor Warren submitted exclusive statements in response to some questions, offered material from his "record" on others.

General MacArthur received the questions personally from Alpheus W. Jessup, McGraw-Hill World News man in Tokyo. The cabled reply: *"After long, serious consideration MacArthur refuses to answer industrial questions. Claims adequate answers require many study hours. He is too busy with occupational duties."* Since MacArthur has no public record on these matters, it is impossible to summarize his views.

Governor Stassen had already stated his position in his book, *Where I stand* (Doubleday & Company). His answers are from that source.

Voting records and public statements of the other candidates were examined, and the quotations and summaries are based on that material.

1. LABOR RELATIONS: Is the Labor Management Relations Act promoting or obstructing industrial peace? On the basis of experience, how should it be modified, if at all?

DEWEY: "The objectives [of the act] to cure inequities or injustices arising either from practice or earlier labor legislation . . . were soberly conceived and carefully thought out in order to enlarge the rights and privileges of all the working people of the nation. With such modifications as experience may prove necessary, the act should serve the people of the nation well."

MARTIN: "The law will go down in history as a great charter of liberty for working men and women in America. The worker has just rights, too, and they must be protected."

He believes that operation of the Taft-Hartley Act thus far has not upset organization of labor materially; certainly it has not become a "slave labor act," as prophesied by union leadership. Whether it will work out successfully as mediation machinery depends on the test being given it now.

STASSEN: "[The law] is very close to the labor policy I urged. . . [It] goes a bit too far in some particulars. But not very much, and not enough to be a serious defect. . . It keeps the Wagner Act in force with only such revision as time and experience have shown to be desirable. . .

"I believe the passage of time will prove that the law is a good one. Some have pronounced it impotent because it contains no provisions which would absolutely prohibit another crippling coal strike. It is true that there are no such provisions. If we ever do enact such provisions, we would be making a tragic mistake."

TAFT: As Senate sponsor and co-author of the act, Taft stands behind the act almost 100 per cent. He believes a too rigid interpretation is being given the section (304) on political spending by unions, and is reported to feel that this section may have to be reworded to insure application in line with Congressional intent.

Speaking through the Joint Senate-House "Watchdog" Committee, he said, "No information has been received . . . indicating the need for amendment at this time." He is reported to feel that no attempt should be made to amend the act during an election year, unless some section is upset by the Supreme Court.

Taft holds that the act deserves at least partial credit for the relative peace which has prevailed on the industrial front since last June.

TRUMAN: "I made my attitude clear on this act in my veto message to the Congress last June. Nothing has occurred since to change my opinion of this law."

In a radio broadcast last June 30, he said: "It is a bad bill for labor, bad for management, and bad for the country . . . designed to weaken labor unions. [It] would take labor relations out of the plants [and] place them in the courts."

VANDENBERG: "New monopoly power of labor leadership must be tempered with greater rank-and-file democracy." In apparent support of that credo, the Senator voted for the Taft-Hartley Bill, and for its predecessor, the Case Bill. He favored the act limiting portal-to-portal back pay suits by labor as well as the President's Emergency Strike Bill (which followed the 1946 railroad strike).

However, he is sometimes reported to have certain reservations with regard to portions of the Taft-Hartley Act. He is said to have remained silent on this point to insure party harmony on foreign aid.

WALLACE: "The Wagner Labor Relations Act gave to labor certain basic rights of collective bargaining which reduced the inequality of bargaining power in industry resulting from the overwhelming economic strength of large corporations. The Norris-LaGuardia Act, prohibiting the use of the injunction in labor disputes, protected the right to strike. Together, these pieces of legislation led to a relative balance between labor and management.

"After the first two years of the Wagner Act, when employers came to realize that they had to participate in collective bargaining, industrial relations were generally peaceful and strikes at a low level. This legislation helped assure industrial peace during the war.

"The Taft-Hartley Act has destroyed the bargaining balance in industry. Labor is weakened by the political means test of the anti-Communist affidavits. The right to strike is seriously limited by the requirement for prolonged advance notice, and the authorization of injunctions which force the calling off of strikes for an 80-day period.

"Industry no longer has the incentive to bargain collectively. Labor has no hopes of winning anything by negotiation.

"This can only result in a very serious outbreak of strikes, in the return of labor spies and armed strike-breakers, in violent industrial conflicts.

"The Taft-Hartley Act should be totally repealed."

WARREN: "The Labor-Management Relations Act of 1947 should be continually re-examined. There should be no hesitation about amending it to correct deficiencies demonstrated by actual experience. The demand for legislation of this kind arose out of our neglect to develop a national labor relations policy gradually through the years.

"When crippling industrial disputes of the last few years accentuated the problem, the President urged Congress to adopt legislation on the subject. Congress was obliged to deal with the whole subject at once, acting under pressure of intense emotion on the part of both proponents and opponents of the legislation. It would be too much to expect that under such circumstances the present act would cover all exigencies or satisfy either side.

"Everyone now has his own ideas about specific

provisions of the act. Congress itself recognized the probability of amendment by setting up an interim committee to study its effects. If any provisions are found to be oppressive, unnecessary, or unworkable, they should be changed until the act fully guarantees democratic principles within labor organizations and establishes a sound national policy based upon equity to employers, employees, and the public in the process of collective bargaining and in the settlement of labor-management disputes."

2. INDUSTRIAL WAGES: Is the present general level of industrial wages too high; too low, or about right? If too high or too low, what course should industry, labor, and government follow to bring about corrections?

DEWEY: No comments available.

MARTIN: Favors increasing the present 40-cent minimum wage, has not settled on 60 or 65 cents. He believes that if business would offer incentives to workers in the form of better working conditions, better security benefits, and so forth, disputes would be lessened. He strongly favors high wages, so long as productivity of the labor force is high.

STASSEN: No comments available.

TAFT: "In the last eight years, the net [financial] condition of all workers on the average has increased 40 per cent. If we can do another 40 per cent in the next eight years, no one could be more pleased than I. . . . I think labor unions are entitled to get the wage [for members] that is justified in the industry in which they are—a return equal to the productivity of the things they are producing in that industry.

"There isn't any doubt that in many industries the wage earner is entitled to more and ought to get more, certainly up to the cost of living, but rather in accordance with the increased productivity."

Taft is known to favor increasing the minimum wage to 60 or 65 cents an hour. He disagrees with the theory that wages can be increased in times of tight supply and high demand without increasing prices.

TRUMAN: "Income should increase . . . consistent with the maintenance of sound price, profit, and wage relationships with increased productivity. One-fifth of our families now have average annual incomes of less than $850. We must see that our gains in national income are more largely made available to those with low incomes. . . Our 40-cent minimum wage is inadequate and obsolete. I recommend lifting the minimum wage to 75 cents an hour."

VANDENBERG: "I would seek for labor the highest practicable wage. But I would recognize the fact that high wages must be accompanied by high production, or high prices will continue to nullify net gain and will pyramid to ruin for all concerned."

WALLACE: "In view of the present price level, and taking into consideration the high profits of 1947, the present level of wages is generally too low. With $52.27 per week, or a little more than $2700 per year, the average industrial worker and his family are $1350 per year below the Heller budget minimum necessary to provide a decent living to a family of four.

"Over the past three years, average real weekly earnings have dropped more than 15 per cent in purchasing power.

"The present low wage situation threatens the economic stability of the entire country. Already there has been a reduction in the volume of sales of consumer goods. With a ceiling on ultimate markets, manufacturers are hesitant to expand their capacity, and as a result, according to the McGraw-Hill survey, industry's post-war expansion program will be largely completed by the end of this year.

"The government and, unfortunately, many manufacturers are currently attempting to initiate a war-preparations boom to substitute for necessary peacetime adjustments. This may maintain high profits at the expense of the American people for a while, but can only lead to disaster for industry and labor.

"To restore economic balance, industry should seriously bargain with unions for the substantial wage increases which are in order this year. For example, increases in prices and productivity in the steel industry during the past year would justify wage increases of at least 30 cents per hour. Congress should raise the minimum wage under the Fair Labor Standards Act to $1 an hour, and extend it to all workers. The present basic work week of 40 hours should be maintained."

WARREN: "No comment."

3. WORKER SECURITY: How much further should industry and government go in providing worker security?

DEWEY: No direct comments available, but Dewey has supported (in New York) a Fair Employment Practices Commission, liberalization of unemployment insurance and extension of both the Workmen's Compensation and Minimum Wage Laws.

MARTIN: No comments available beyond those reported in Question 2 (Wages).

STASSEN: Generally considered a "liberal" among Republicans on social issues, Stassen has endorsed

numerous public and industrial "security" programs.

For example: "Provision should be made for a federal-state insurance approach to the exceptionally heavy doctor and hospital bill. Every American now on the Social Security rolls could be provided with insurance against hospital or medical expenses in excess of $250 a year.

"Such a program would leave all the normal hospital and medical costs—those under $250 in a single year—to be handled as they now are. This would avoid placing the government in an overshadowing bureaucratic role, and would keep the medical profession from becoming subordinate to a government insurance agent. The program I suggest could easily be coordinated with the Blue Cross and other private and voluntary insurance plans. . . Those [not covered by Social Security] could enter the insurance plan on a simple basis by payment of an annual fixed fee."

TAFT: "We should go forward in this field of public welfare, within the principles of American government and freedom. The important fields to be covered are old age, surviving children, compensation and relief for the unemployed, health, and housing; and, in a different category, education. This is primarily a community responsibility, and the great bulk of the work can be and should be done by local government. It is only when the local government is unable to do the job that the states are called in, and, finally, appeal is made to the federal government."

"The principal justification for this is the lack of adequate state and local revenue and taxing ability. . .

"Federal assistance must not bring federal control. The responsibility for administration must rest in the states and local governments and in officials responsible directly to the people of the community. . . . It must be recognized [also] that the role of the federal government is secondary and supplementary. . . The aid must be only to provide a minimum standard of health, relief, and housing, not a standard we would all like to see our people attain."

As to specific programs, Taft has said:

"There should clearly be a complete study of the whole Social Security system and some plan developed for coordinating it with supplementary voluntary plans. . . We can consider, as one possibility, voluntary federal insurance in addition to basic Social Security."

"In the field of unemployment compensation, I believe we should establish a federal aid plan with state administration for use in emergencies only. . . I would be much opposed to reestablishing a federal WPA."

"We cannot get rid of the substandard housing and keep all housing at a decent level, without a further development of public housing. I find no practical method of subsidizing the lower income groups who require housing, except by providing a limited amount of public housing. . . If the subsidy extends only to those of the lowest income groups, it is not socialism."

TRUMAN: "Employees of small business and as many other groups as feasible should be brought under an extended coverage of unemployment compensations."

He recommended broadening of Social Security—old age and survivors' insurance. He has endorsed the Wagner-Murray-Dingell bill that would finance health insurance for all citizens from increased compulsory Social Security payroll taxes.

VANDENBERG: "Aggressive social progress without state socialism [is the right policy]." He is an advocate of profit sharing as a material factor in achieving security for workers and promoting industrial peace.

Vandenberg is for increased coverage of old age insurance—but on a pay-as-you-go basis. He also supports the Fair Employment Practices Bill. During the 'thirties he was notable among Republican senators for his support of many of the milder New Deal social reforms. He fathered the act creating the Federal Deposit Insurance Corporation.

WALLACE: "Our present laws contain only a faint beginning toward providing workers' security. Most industrial countries have social security laws far more advanced than ours. Unemployment insurance should be extended to all workers in industry, trade, and agriculture; old age insurance should be extended to all people—workers as well as self-employed. The basic scale of benefits for these types of insurance should be increased and should be organized on a uniform national basis.

"A broad national health insurance program should be established, recognizing the right of every citizen to adequate health services regardless of his economic status, and providing for construction of hospitals and educational facilities necessary to supply adequate medical services.

"Perhaps most important in providing real workers' security is to carry out a real, long-range full employment program. Some of these objectives were covered in President Roosevelt's Economic Bill of Rights. They were badly watered down in the Employment Act of 1946. However, if the right kind of Congress is elected, and the act were vigorously administered, it could help greatly in meeting the unemployment problem which will become apparent as soon as excessive war preparations are cut down. The new party will carry out a long-range full employment program."

WARREN: "Here in California a great deal has been accomplished to promote the security, the health, the safety, and the welfare of wage earners and their families. We have been able to keep California among the most enlightened states of the union in many fields.

"We have liberalized the Workmen's Compensation Act through increase in the scale of its injury and death benefits for the victims of industrial accidents.

"We have been able to extend the application and increase the benefits of our unemployment insurance system. That system today covers establishments employing one or more persons; the waiting period has been reduced from two weeks to one; and the benefit period has been extended to 26 weeks; the maximum benefits have been increased to $25 per week. And with this we have successfully pioneered disability insurance to protect those whose unemployment is due to sickness or non-industrial accidents.

"We have also been able to reorganize and strengthen the Industrial Accident Commission to enable it to render more prompt and considerate service to wage earners. Not only have we moved forward with the inauguration of a number of long and badly needed safety orders, but we have given new life to the whole safety program which involves the modern, and hazardous, conditions under which men and women must work.

"The minimum wage for women has been increased from 45 cents to 65 cents per hour—an amount exceeded by no other state."

Warren has tried for some time to get a health insurance program of some sort adopted by the California legislature, submitting proposals for a comprehensive system of prepaid medical care and for a more limited system of hospital and laboratory insurance. On public health he has said:

"American medical science has surpassed that of any country in the world, but, unfortunately, as the standards are raised, the cost of medical care becomes much greater and to that extent it becomes less available to people of modest incomes.

"A major operation or a serious illness is a financial calamity for the family of the average working person.

"This is due to the fact that we have not applied the principle of insurance to our problem of health and medical care as we have to most of the other hazards of life.

"I believe that, if we do apply the insurance principle in this field through a system of prepaid medical care to which all will contribute, we will spread the economic burden attendant upon unpredictable illness, place the costs on a pay-as-you-go basis, and thereby assure for our people the ability to meet the costs when illness strikes.

"Health insurance can be made available to everyone without socializing either our hospitals or the medical profession. Freedom of choice on the part of physician, hospital, and patient can be preserved and the highest medical standards maintained.

"I believe that the health of the people is the responsibility of state government. This responsibility has not yet been met in any state of the union. Any program of the federal government in this field should, in my opinion, be limited to such subsidies, accompanied by fixing of minimum standards, as will encourage and assist the states."

4. TAXES: What changes, if any, should be made in our corporate tax structure?

DEWEY: "Change and lower the income tax on incorported business companies until it no longer acts as a drag upon production. . . Wartime taxes [tended to] encourage waste and inefficiency, discourage low-cost production, and block expansion which creates job opportunities."

Dewey cut the New York State business franchise tax and the unincorporated business tax by 25 per cent. He claims this reduction has "paid off" by being a major factor in the some 130,000 new businesses established in New York since the end of the war.

MARTIN: Feels expansion of the industrial plant is the only sound way of insuring high employment, high wages, and a price structure that will move merchandise from plant to consumer. He says that is why he has so strongly urged tax reduction—to give investors risk capital with which to expand our economy. He believes that the Treasury will not lose all the $4,800,000,000 involved in the new income tax reduction law. The tax law will stimulate business activity, which in turn will be taxed for most of the cut.

However, Martin is not unalterably opposed to increasing taxes should the expense of rearmament require it. But he wants the new lowered tax rates to operate for the remainder of this year—make sure whether any revenue will be lost—before reviving the higher rates. Above all, he fears that a return to deficit financing would be chaotic.

He sees the new tax law as a benefit to young people starting out in business and homebuilding.

"I can see where those who have plenty of surplus might want the entire savings to be devoted to liquidation of the national debt, but not the millions of young people striving to get ahead in the world."

STASSEN: "Along with a ceiling on taxes of not to exceed one-half of current income, to be taken by the federal government, I would suggest that there also be a floor on taxes.

"In other words, those with accumulations of capital should pay certain minimum federal taxes even though they hold their property in a stagnant condition without appreciable income. . . This could be arranged by a provision that all fortunes in excess of a certain amount must pay in total taxes of all kinds at least 1.5 per cent per year of the principal."

TAFT: He has said generally he favors overhauling the *entire* tax structure, but no specific comments are available on corporate taxes.

TRUMAN: On three occasions the President has vetoed a Republican-sponsored individual income tax reduction bill. Speaking January 7, 1948, he offered as an alternative a $40-per-person tax credit designed to give relief to low-income groups. He generally favors extension of the split-income provision for income tax purposes, but has, up to the present, opposed any change in the tax structure that would reduce revenues. He suggested raising corporation profit taxes to make up the difference.

VANDENBERG: He supported all three of the vetoed bills that called for cuts in personal income taxes. He is known to believe that, for incentive purposes, corporations should be given tax exemptions for money paid out under a profit-sharing system.

WALLACE: "Our present corporate tax structure has two main weaknesses. It doesn't get as much revenue

as should be obtained from the wealthy corporations, and it taxes the largest and most powerful corporations on virtually the same basis as smaller and medium-sized firms. I favor a corporate tax structure which would provide exemptions for the very smallest corporations and a graduated scale of taxation for medium-sized and larger firms.

"The first $10,000 of corporate net profits should be exempt from tax. The corporate tax rate would then start at 20 per cent on corporate net income over $10,000; rise to 45 per cent over $100,000, to 75 per cent over $1,000,000, and to 80 per cent on all net income over $5,000,000.

"As a further assistance to independent enterprise, and especially to new and expanding enterprises, accelerated depreciation for tax purposes should be permitted on new buildings and installations up to a certain amount, say, $500,000 a year."

WARREN: "Our present financial condition requires that, if the United States is to remain solvent, we must stop deficit financing and commence paying off our national debt.

"Any sound tax program for the future requires, first, a balancing of the budget, which should include a substantial annual payment on the national debt.

"The budget itself should reflect every ecenomy that can be effected without crippling essential and humanitarian services to the people or the national defense.

"If the present tax rates provide more money than is necessary to accomplish the above purposes, taxes should be reduced to the extent of such excess.

"On any tax reduction, ability to pay should be recognized, as it should be in the fixing of tax rates.

"The federal tax program should be designed further to encourage the re-investment of corporate profits and the surplus income of individuals in productive enterprises upon whose continuous expansion the American people depend both as workers and as consumers."

5. GOVERNMENT CONTROLS: Under what circumstances should the government control the prices and allocation of industrial materials? Of consumer goods?

DEWEY: "Instead of controls being maintained until peacetime production could get started, the entire structure of wartime inflation control was undermined by Executive Order of October 30, 1945, relaxing wage controls. This fatal action . . . destroyed the effectiveness of price controls. . . Thus was launched the wage-price-profit spiral."

"Mr. Truman has proposed going back to the controls he abandoned. It won't work now any better than it did before without wage controls, and they should not be restored."

MARTIN: "The nation could not possibly return to price control. . . The New Deal has been promoting inflation for years, and, now that it is here, administration leaders do not know what to do about it."

STASSEN: "Price controls should not be used unless specific necessity items are so scarce as to require rationing, and then only in connection with a rationing program, and at levels sufficiently high to stimulate maximum production."

TAFT: He has consistently opposed government controls of all types. Commenting on the President's November proposal for selective wage, price, and rationing control, he said:

"Such a proposal is not progress nor is it liberalism. It is reaction and a step toward a completely totalitarian nation."

TRUMAN: In his November 17 message to Congress, the President recommended *selected* rationing, price and wage controls, and allocation authority over strategic and scarce materials. He proposed those controls as a way of combatting inflation. As a Senator he supported economic controls as a war measure.

VANDENBERG: He has consistently supported the Republican attack on price controls. He favored "the earliest possible termination of all war controls—with rare and temporary exceptions where supply lags far behind demand."

We must have, he said, "maximum demobilization of bureaucrats and overlords. . . Red tape must be fought as relentlessly as red ink. . . Vigilant preservation of free competition against monopoly [is needed]."

WALLACE: "In the answer to Question 7 I shall indicate my opinion as to the desirable extent of government controls under present circumstances. I am opposed to controls for the sake of controls, but favor controls when they can make a real contribution to the public welfare. Beyond this, it is impossible to make any general statement as to the circumstances under which controls are appropriate."

WARREN: "Recognizing the necessity for cost-of-living controls in time of war or great national emergency, I share the aversion that most Americans have for such controls in time of peace.

"It is my belief, however, that if the cost-of-living controls of World War II had been lifted in a more systematic and orderly manner over a longer period of time, the inflationary conditions of today would not be so distressing to millions of American citizens.

"If these conditions become progressively worse, and prices continue to rise in a runaway fashion beyond the ability of the average working man to pay, it may become necessary again to consider seriously relief through re-imposition of some system of price control or allotment of scarce basic materials. Under no circumstances should the welfare of the American people be sacrificed to the grasp and greed of profiteers."

6. GOVERNMENT REGULATION OF INDUSTRY: To what limits may government properly go in its regulation of private industry? Under what circumstances, if any, is government justified in "taking over" or "competing with" private enterprise?

DEWEY: "Government cannot operate industry efficiently or in the public interest and it should never do so except in the operation of the development of a great natural resource, where the powers of the government may be necessary."

MARTIN: No comments available.

STASSEN: "We must vigorously oppose all monopolistic practices of big business. We must insist that big business compete with other big business, and that the avenues of small business competition also remain open. . . We must not permit major political power to be added to the other great powers that are accumulated by big business. Excessive concentration of power is a threat to the individual freedoms and liberties of men, whether that excessive power is in the hands of men of government or of capital or of labor."

TAFT: No direct comments available on regulation (as distinguished from controls). He is known to look with disfavor on TVA and extension of public power. He voted for the Reed-Bulwinkle bill to exempt railroads from anti-trust laws. He opposed the reciprocal trade agreements.

On the other hand, he has supported continuation of both wartime controls over scarce materials (tin, antimony, and so forth) and the government synthetic rubber program.

He also favors strict enforcement of the anti-trust laws. For example "There is some monopoly and monopoly ought to be gone after and prevented. I believe very strongly that competitor can be enforced."

TRUMAN: "Growth and vitality in our economy depend on vigorous private enterprise. Free competition is the key to industrial development, full production and employment, fair prices, and an ever-improving standard of living. Competition is seriously limited today in many industries by the concentration of economic power and other elements of monopoly. The appropriation of sufficient funds to permit proper enforcement of the present anti-trust laws is essential. Beyond that we should go on to strengthen our legislation to protect competition."

Truman generally holds the philosophy that government should participate in business only to the extent necessary for national security and well-being; that is, when private enterprise either cannot or will not take the necessary steps. *Example:* Wartime government control of synthetic rubber industry, only recently extended for two more years, and the proposed Krug-Forrestal synthetic petroleum industry program, which would require government (Reconstruction Finance Corporation) participation in operation of plants if private industry did not do the job.

VANDENBERG: No comments available.

WALLACE: "In our present highly integrated society, business depends upon government for a wide range of essential services. Without the intervention of government today, foreign trade would be chaotic, the whole transportation system would be disrupted, and anarchy would prevail in industry-labor relations. Correspondingly, government may properly go as far in its regulation of private industry as the general public interest requires.

"Government should properly operate those enterprises which are made possible by government-owned resources, government research, and government investment. This includes tidelands oil, atomic energy, and river valley developments. Government may properly take over industries which in private hands are a menace to the public safety, such as the aircraft industry which advocates excessive war preparations because under private ownership it has not been able to make profits out of civilian manufacture. Government may take over or compete with those key industries which are monopoly-controlled and exert an important influence throughout our economic life."

WARREN: "No comment."

But Warren has consistently advocated industrial controls within the field of worker safety and improved working conditions. He is strong for government development of water resources. In supporting the California Bureau of Reclamation's Central Valley Project, he said:

"It may well be that some of this power should and will be sold to the private utility, but it should not be the only customer, because if such were the fact, the development of our water resources—in fact, the development of our entire economy—would be geared to the program of a private utility."

7. INFLATION: What measures should government, industry, and organized labor take now to combat inflation?

DEWEY: "We must adopt basic government policies to halt the inflation of the money supply and to stimulate increased production. We must reduce government spending; restrain further expansion of bank credit for speculative or non-productive purposes; expand the sale of government savings bonds; encourage other savings; maintain a government surplus and use it to retire bank-held government debt; and

revise taxes to provide incentive for production and thrift while maintaining luxury spending penalties."

"In boom times, governments—state and local as well as federal—should save money, retire debt, defer postponable public works, and strengthen their credit. In hard times, they should undertake the public works they have deferred."

MARTIN: Only production and reduction of government expenditures will whip inflation. He would clean out the federal bureaucracy, and return to the states many of the public functions taken over by Washington in the last 15 years. He is on the record for full re-armament at whatever expense is necessary, but demands that the military establishment justify completely its request for funds.

STASSEN: "Exhorbitant prices should be met by nation-wide officially encouraged voluntary boycotts of specific 'bad examples' for limited periods to drive down prices and improve the supply-and-demand ratio. Every effort should be made to encourage higher production. Where it can be attained, this is the best answer to high prices. Strong consumer credit controls are needed to hold down purchasing power."

"Any time the unemployment in this country (other than seasonal unemployment) goes over, shall we say, 6 per cent . . . a special cut in all taxes should go into effect. In addition, consumer and installment-buying credit (held firmly in limits in boom years) should be eased. A major program of worthwhile government improvements should be put into gear at once . . . by private contracts and not on a WPA basis. . .

"Whenever employment climbs back up so that less than 4 per cent (other than seasonal) are unemployed, taxes should go back up to the maximum peacetime level, consumer-installment credit controls should be put on, government spending should be sharply reduced, and reserves should be built up."

TAFT: "The government, I think, can put its own house in order, can reduce the taxes, and the government spending, because [those expenditures] simply add to the prices. In the long run taxes are passed right on to the consumer. The government, I think, is interested in seeing that the saving and spending are in balance, that agricultural production is in balance with industrial production, wages are in balance with prices. . .

"Encourage people and corporations to save and invest their money in productive enterprise. Keep the market free from monopoly; keep collective bargaining free and equal. . . Reduce government expenditures and taxation, particularly for armament, when possible, so our production of civilian goods can be increased, instead of military goods."

Taft also sponsored the so-called Taft-Wolcott Anti-Inflation Act, providing for voluntary allocation agreements without anti-trust restraint.

TRUMAN: In his message to the extraordinary session of Congress last November 17, the President proposed a 10-point anti-inflation program:

1. Restore consumer credit controls and tighten bank credit.

2. Regulate speculative trading on the commodities exchanges.

3. Extend and strengthen export controls.

4. Induce marketing of livestock at weights reflecting most efficient conservation of grain.

5. Allocate transportation equipment and facilities.

6. Intensify farm conservation, assist in increasing foreign food production.

7. Control scarce commodities which basically affect the cost of living or industrial production.

8. Re-institute consumer rationing of meat and other cost-of-living items in short supply.

9. Extend and strengthen rent control.

10. Re-institute price ceilings on cost-of-living items in short supply, and re-institute such wage ceilings as are necessary.

VANDENBERG: He has urged restraint in pricing to ward off consumer resistance. He supported the Taft-Wolcott Anti-Inflation Act which gave the government authority to establish voluntary industrial committees, protected from the anti-trust laws, to work out agreements for the allocation of scarce materials.

WALLACE: "Price control should be reinstated for the purpose of rolling back the prices of foods, clothing, and other key consumer goods items; for rolling back prices of steel, petroleum, and other key industrial materials. Grey markets should be eliminated by strict government allocation of such key industrial materials as steel, in order to end present discrimination against small and independent firms in the supply of these materials.

"The loopholes in the present inadequate rent control law should be closed, permitting no further increases in rents. A national housing program should be enacted, providing for construction of 2,000,000 homes a year at prices ordinary people can pay."

WARREN: "The basic reason for the present inflationary trend is that our demand for goods far exceeds our supply. We are all competing for goods that are not being produced in proportion to our increased national income and the number of people now employed. Higher standards of living have produced customers for more goods. Arbitrary practices in industry and labor, wartime depletion of our resources, and diversion of billions for foreign rehabilitation, all tend to limit the available supply of goods and services.

"Because no single thing has caused this condition, no single measure will remedy it. We must, however, either produce more or use less. Failing to do one or the other, we must regulate either the use of goods or their price, or both. If voluntary measures prove ineffectual, we must resort to legal measures—export and credit controls, or price, wage, and use controls. We must have the courage to try some or, if necessary,

all of these things unless the inflation spiral is otherwise curbed. The need for bank and consumer credit controls, and for export and rent controls is already apparent. Peacetime controls are distasteful to me as they are to most Americans, but, however distasteful, I should prefer them to a runaway inflation."

8. COMMUNISM: What should be the policy of industry, labor, and government toward Communists in the United States?

DEWEY: "I propose that we start effectively countering the evil propaganda of Communism with the truth. . . We are actually being licked day after day by the propagandists of a nation that has nothing to sell but slogans."

"We simply have to recognize that [the Communists] are here to destroy us and everything we believe in. We have quite a lot of them in New York, and they have done me the honor of labeling me as their Public Enemy Number 1 because they can't make any headway in the state government and because we beat them so badly in the elections."

"That is why I disagree with some of the pronouncements of those who are inexperienced in dealing with Communists. I like to keep them out in the open where we can beat them."

MARTIN: He has spoken often about Communism in government. He said it was his belief after a speaking tour of the country last fall that, next to tax reduction, the people wanted Communists ferreted out of government departments.

He favors exposure of Communists in other segments of social life, rather than statutory outlawing of the Communist Party, which, he thinks, would drive the Reds underground rather than wipe them out.

STASSEN: "I would give these twelve specific steps as the most effective program to combat Communism. . . (1) expose thoroughly the identity of all known Communists and fellow-travelers. . . (2) insist that they stand up and be counted . . . that they do not hide behind false fronts, false names, or false issues; (3) prosecute them vigorously for their violations of law. . . (4) have basic faith in the American working people and keep them fully informed of the facts; (5) meet squarely, through frank discussion of the merits, the issues the Communists raise; (6) move continually to correct deficiencies, maladjustments, or evils which they point out. . . (7) expose the unsound and disruptive proposals that they make; (8) urge our fellow-citizens to refuse to associate with them in organizations. . . (9) do not lightly use the charge of 'Communist' against anyone unless we are certain of the evidence. . . (10) ban them from public payrolls, federal, state, or local; (11) see to it that members of labor organizations have a chance to vote by secret ballot on their own officers so that the workers can remove union officials who are exposed and proved to be Communists; (12) take all these actions with complete respect for civil liberties and legal rights."

In recent primary campaign speeches, Stassen has declared that members of the Communist Party are acting as agents of a foreign power, and has proposed statutory outlawing of the Communist Party in the United States.

TAFT: "In Communism we face a curious form of aggression. But outside the power of the Russian army limited to Europe and Asia, it is a battle of ideologies. We cannot fight the ideology of Communism with soldiers. War in itself creates a condition favorable to totalitarian government, and therefore to Communism.

"We should meet Communism first here in the United States, bring it out into the open and eliminate its influence. If we can't meet it successfully at home, how can we hope to meet it in Europe? Our leaders should speak out in behalf of the American system and get away from the inferiority complex about it we have seen in recent years. The time has come for leaders of all our parties to point out the merits of the American system, and the principle behind it."

TRUMAN: On March 22, 1947, the President issued an executive order calling for a loyalty check of all government employees, with the Federal Bureau of Investigation making investigations and a Loyalty Review Board deciding cases.

VANDENBERG: No comments available.

WALLACE: "Communists should be treated by industry, labor, and government just as other people are treated. Persecution of Communists is just as harmful as discrimination against Negroes and other minority groups. All forms of discrimination on account of race, religion, or politics will have to be abolished before our American democracy is 100 per cent effective.

"So far as Communism is concerned, I have always held that ideas cannot be fought with guns, prisons, or blacklists. I favor a progressive form of American capitalism which will give real play to private competitive enterprise as distinct from monopoly, and at the same time provide rising living standards to all of the people. The successful carrying out of this program is the only way to combat the idea of Communism in the United States."

WARREN: "No comment."

But Warren has said that he is opposed to the feature of the Taft-Hartley Act which requires union leaders to sign affidavits that they are not Communist. He maintains that, if such a ruling is made, it should apply also to corporation officials. When a state loyalty check bill was introduced, he commented that he had full confidence in state employees and saw no need for an inquiry by an official agency.

Truckman calls in from box in department at the end of each run...

TWELVE CALL BOXES are strategically located throughout the million-plus square feet of Wagner Electric plant. By calling in immediately after he has made a delivery, truckman avoids need to return empty to base for another assignment

POWER TRUCKS EXPEDITED

Handling costs drop as dispatcher controls a fleet of 36 trucks with a plant intercommunication system

R. H. HACKETT • PLANT ENGINEER, WAGNER ELECTRIC CORPORATION ST. LOUIS

A FLEET of 36 industrial trucks is now directed to the right place at the right time by a two-way communication system spanning out from a central dispatch station at Wagner Electric. The result is that every truck now carries a pay load on virtually every move, and the production time spent in waiting for trucks has been reduced to a small fraction of its former total.

Prior to the new installation, truckers were forced to go back to their home station for reassignment on the completion of each job. If nothing happened to be waiting for them, it was not unusual for them just to cruise about the plant looking for work. It is estimated that just such "unavoidable" causes as these kept trucks and operators idle 30 per cent of the time.

The old system. When a truck was required to perform a certain handling operation, the departmental supervisor or production expediter would telephone a materials handling station. When a truck came in, or could be located somewhere, it would be dispatched. This procedure had two unhappy results. First, if the proper truck could not be located immediately, a "second best" was sometimes dispatched with the result that it had to return empty, incapable of handling the load. Second, many times materials that were not critical in the production picture would be moved, while others of a really strategic nature just waited.

A first revision. An initial step toward the solution of this problem took the form of requiring truckers to call in after delivery of each load. They were told to use any telephone in the factory that happened to be handy. This helped, but was still wasteful and inefficient. Telephones were not necessarily located near loading or unloading stations. Thus, it was often necessary for the trucker to park his vehicle and walk to the nearest telephone. Time was still being wasted; fuel consumption was still excessive; and critical materials were still occasionally being held up.

The present system. A master communications "call" and "receive" set is now located in the cen-

...Dispatcher directs him to nearest pick-up for his type of truck

CENTRAL DISPATCHER keeps file, by department of origin, of move orders received over special telephone line. Checking his file, dispatcher can send trucker to pick-up nearest the call box, or direct him to any rush job that may be pending

THROUGH CENTRAL CONTROL

tral dispatching office. Through this medium, the dispatcher is in constant touch with 12 remote substation call boxes located at strategic points throughout the plant. These substations are standard intercommunication boxes bracket-mounted on the walls. Truckers call the dispatch office from the nearest box at the end of each run.

By referring to his area chart, the dispatcher can tell at a glance where the trucker is calling from. Another chart on the wall of the dispatch office shows the type of truck, whether it is gas or electric-powered, the condition and capacity of the truck, and the operator's name. This information forms the background against which the dispatcher makes the decision as to the next move for the truck.

Orders for moves from foremen, production expediters, or others related to the production picture are received by the dispatcher over a special telephone line. This line is restricted to calls for truck and material movement requests only. The person requesting such a move gives the dispatcher complete information on the nature of the load to be moved, the location of the material, and its destination. The dispatcher enters this information on a 3x5 interplant traffic order form.

These forms are maintained on clip boards close to the dispatcher for ready reference. Clips are provided on the board for each factory area and department. Rush orders are always placed in the front of the clip.

Thus, when a call comes in from a trucker, the dispatcher need only refer to the traffic orders filed under point of origin in the department or area from which the trucker is calling. If the job required by the traffic order on top of the pile can be performed adequately by the piece of equipment operated by the trucker who is calling, the dispatcher relays the information, and places the order in a pending file until the trucker's next call. If, however, the particular piece of apparatus cannot perform the job on the top order, the dispatcher merely riffles through the stack of orders for moves originating close to the point from which the call is being made, and dispatches the truck to the first one for which it is suited.

The new system is paying off three ways:

1. An increased tonnage is being handled with the same fleet of trucks, eliminating the necessity for additional equipment.

2. Production delays caused by breakdown in the trucking system are minimized.

3. There has been a marked reduction in direct handling cost per unit of product.

How hourly workers | supervisors | and all employees | answered . . .

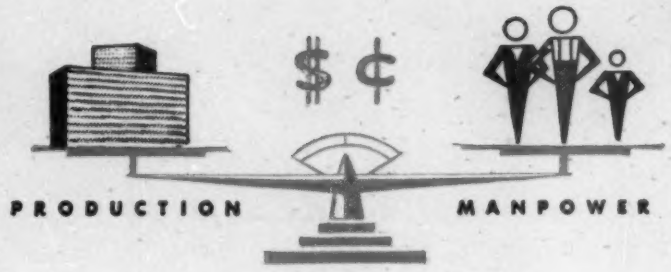
WHERE DO WAGE INCREASES COME FROM?

Feelings and opinions are strong on the subject of wage increases. It looks like more good old common sense is needed on this subject. The present feelings are understandable, but do not add up.

QUESTION

Does the average worker think wages are increased because—

ANSWER



				%
Employees are able to demand it.	8.79	26.04	17.65	
The company can afford it.	10.99	15.63	13.37	
He is able to produce more.	24.18	30.20	27.27	
He needs more to live.	56.04	28.13	41.71	

EMPLOYEES FEEL "AT HOME" WHILE "ON-THE-JOB"

QUESTION
When I started at Aeroquip everyone helped me feel welcome and "at home".
ANSWER

				%
Agree	92.31	83.33	87.56	
Disagree	5.49	10.78	8.29	
Don't know	2.20	5.89	4.15	

THIS SMALL PLANT MADE

Here's how the survey was made. And why. The company president also tells what management gained from it

PETER F. HURST • PRESIDENT, AEROQUIP CORPORATION, JACKSON, MICH.

"To get results in dealing with people, management must recognize the nature of people."

Those were the words I used in announcing our employee morale survey to Aeroquip management. As a result of the survey, we feel that today we know a great deal more about the nature of the people at Aeroquip, and are therefore in a far better position to deal with them and to work with them.

For example, we found out that while 40 per cent of our hourly paid employees are completely satisfied with the cafeteria, another 52 per cent feel that, while the food is all right, it should be better. Similarly, when asked if it is necessary to "play politics" to get a promotion or increase, only 52 per cent were sure it is not. The other 48 per cent split evenly: half said it *is* necessary, half replied *don't know*.

To obtain this information, we submitted a questionnaire to each of our 300 employees. Most of the "questions" were in the form of positive statements; the employee was asked to express his agreement or disagreement. Some were of the so-called "multiple choice" type, similar to those illustrated at the top of these pages.

A high percentage of replies was assured by having the employees answer the questionnaires during

. . . typical questions in morale survey made by Aeroquip Corporation

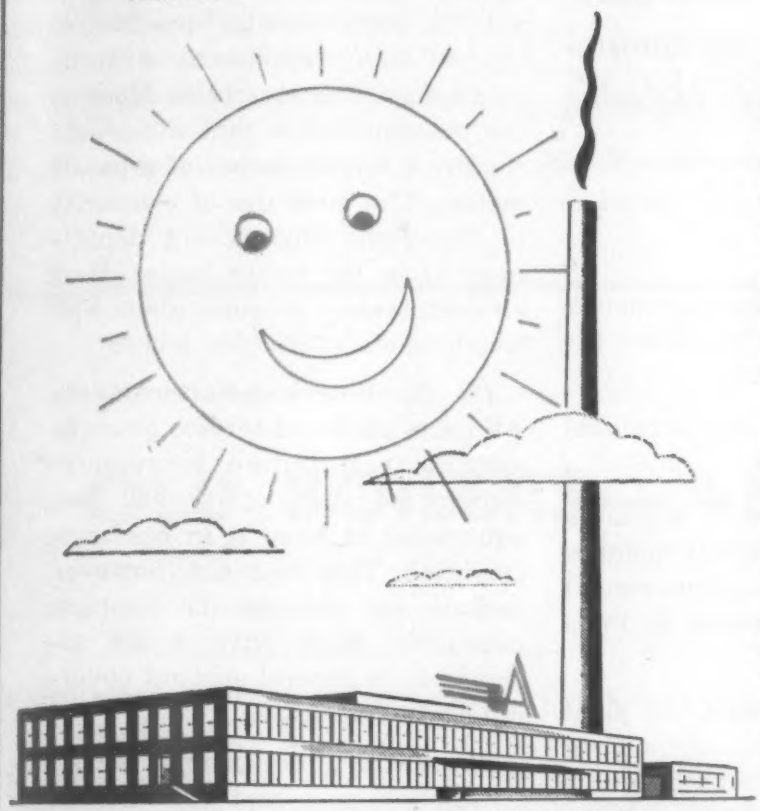
PEOPLE IN JACKSON THINK WELL OF AEROQUIP

Aeroquip employees in general are proud of the company's reputation in Jackson. Here is the opinion expressed by employees on this question:

QUESTION

What do the people in Jackson think of Aeroquip?

ANSWER



A poor place to work; the last place a person would want to work if he had a choice.	1.09	0	0.52
Just like any other factory; very few people know about it.	31.52	18.81	24.87
A company that many people say favorable things about.	39.13	59.41	49.74
A good company for a good man to do a real job and get ahead.	28.26	21.78	24.87

A MORALE SURVEY

"working hours." Complete anonymity was guaranteed by instructing employees *not* to sign. Furthermore, employees were promised, in advance, that each would receive a full report of the results—*regardless of what the results might be.*

Results Were Published

Naturally, we redeemed that promise. We went further. Although the survey showed up some weaknesses, we felt we had reason to be very proud of the over-all results, of the truly fine "esprit de corps" that was indicated. Consequently, the survey report was prepared for publication in the form of an illustrated, 20-page brochure. This was distributed not only to employees, but also to our customers and interested management executives.

One interesting problem in connection with the preparation of the survey was how to avoid "loading" the questions in such a way as to "force" or even "suggest" what management might consider to be the most desirable answers. We solved this, in most instances, by making positive statements, then asking if the employee "agrees" or "does not agree."

To do this, we had to lead with our chin at times, practically ask for an *un*favorable answer. For example, this statement appeared on the questionnaire: "I feel my boss holds a personal dislike or grudge towards me." Whether or not an employee really felt his boss did hold a grudge, if he had reason to be disgruntled over *any* company policy or practice, here was a fine opportunity to express resentment.

Consequently, we felt that the fact only 9.7 per cent of our employees "agreed" with statement indicated generally fine performance by our supervisors. However, we know that even 1 per cent agreement with statement would mean that Aeroquip management still has a job to do. Now better informed, we are getting on with that job.

WE CHARGE THESE EXPENSE ITEMS TO MAINTENANCE

What does the maintenance function cover? Which items of expense are charged to maintenance? What goes into the maintenance budget? What stays out? Here, to assist plant operating men who may have trouble setting up the maintenance account, are the items one company includes

C. L. BRINKMAN • PLANT ENGINEER, THE PARKER APPLIANCE COMPANY CLEVELAND

THE maintenance account at Parker Appliance covers all material costs for building and equipment maintenance, as well as payroll for machine repairmen, electricians, millwrights, pipefitters, carpenters, painters, janitors, elevator operators, and plant protection men.

The following constitutes the breakdown of items within the maintenance account:

1. Supervision. Salaries of the plant engineer, master mechanic, chief electrician, and power plant engineer.

2. Clerical. Salary of one clerk who does all the clerical operations required for the 60-man maintenance division.

3. Cleaning. Wages for janitors and sweepers. Also all contracts for outside service—such as window cleaning, cleaning and repair of venetian blinds, and the disposal of rubbish.

4. Lubricating. Wages of oilers. No materials are covered. In addition, no provision is made for trouble-shooting oil analysis, since this work is all done by the oil companies that supply the plant with lubricating oil.

5. Materials handling. Whenever it becomes necessary to move a piece of equipment that is too heavy for the capacity of the tools available to the plant engineering department, and where this equipment is to be moved either to a place of sale or repair outside the plant proper, an outside rigging company is employed, and its charges are included in this account.

6. Overtime. By any personnel on maintenance work.

7. Night premium. A premium of 10 per cent is paid to any member of the plant engineering department who works on the second or third shift.

8. Operating supplies. All plant engineering supplies, including bolts, nuts, V-belts, electrical equipment, fuses, light bulbs, toilet paper, soaps, wire, valves, fittings, conduit, pipe, and many other items common to maintenance operations.

9. Lubricating and cutting oils. Cost of all lubricating and cutting oils used by the plant. Account is credited at the end of each month with any profit made by the plant engineer as a result of the operation of an oil reclamation system. Cost of operating reclamation system is deducted from total value of oil reclaimed, and remaining amount is credited to this account.

10. Water. Cost of all water used in the plant, whether it is for processing, sanitary, or heating purposes.

11. Gas. Cost of gas used in the plant. Gas is mainly used for hot water and heating purposes, although a small volume is used for heat-treating.

12. Electricity. At present the total electrical consumption, amounting to $4000 a month, is charged to the plant engineering department. A study is currently under way to determine the usage by departments, to see whether it will be economically feasible to charge each department with its own usage. One stumbling block at the present time is that this would require a large number of separate meters. The main use of electricity in the plant engineering department is in the boiler house. Here air compressors consume about $500 worth of electricity per month.

13. Machinery and attachments. All parts used and service given by machine repairmen in reconditioning or repairing new or used equipment to keep it in operating condition. This does not, however, include any charges for complete overhauls. Such charges are assumed by a general account covering capital equipment.

14. Factory equipment. Costs for maintenance and operation of elevators, overhead cranes, and the wages for millwrights who install and move equipment.

15. Tools, jigs, and fixtures. Amount spent for small power and hand tools which are to be used exclusively in maintenance work and which must be purchased from outside agencies.

16. Buildings, general. All building repairs where it is not possible to allocate the expenses to particular departments. Included are glazing, roof calking, painting, and door and floor repairs.

17. Building wiring. All electric wiring for power, light, and intercommunication systems. However, no charges are included for repairs to or changes in machinery wiring.

18. Buildings, heat, ventilation, and plumbing. Cost of operating and maintaining unit heaters and radiators; cost of operating and maintaining air conditioning equipment (toolroom) and exhaust fans;

cost of operating and maintaining washrooms as well as process steam pipelines.

19. Automobiles and trucks. Cost of operating and maintaining one utility dump truck which performs various miscellaneous functions in the department.

20. Plant rearrangement. All work in connection with moving and rearranging departments. This consists of moving machinery and installing new equipment. It also includes the amount contracted to outside riggers for moving within the plant when the facilities of the plant engineering department are not equal to the job.

21. Vacation. All vacation pay for plant engineering employees.

22. Social Security tax. Prorated by number of employees in plant engineering department.

23. Employees' group insurance. Prorated by number of employees in the plant engineering department.

24. Industrial compensation. Prorated by number of employees in plant engineering department.

25. Transfers of expense. This is a credit account in which the maintenance department is given credit for any work, done for another department, which does not normally fall within its allotted duties or budget. For example, should the production department require special tools, jigs, or fixtures, which it could not obtain in the required time from outside sources, they might be made by the plant engineering department. Such costs would be debited to the account for tools, jigs, and fixtures, but would be credited back to the plant engineering budget on the "transfer of expense" account.

OLD BOILERS—AND STEAM COSTS

DAVID MOFFAT MYERS • MYERS, FULLER & ADDINGTON, NEW YORK

ELECTRICAL energy can be purchased almost anywhere and usually at reasonable rates. Industrial plant owners in the United States seldom have to worry very much about an available source of power. They do not have to build a power plant unless they want to. And who wants to? Unless, of course, there is a chance to generate very cheap byproduct power from the process steam, or other sources.

But steam supply is a horse of another color. In most cases the owner has jolly well got to make his own steam whether he likes it or not. And I can't at the moment recall the expression of any warm enthusiasm about the idea.

It would be delightful for plant owners if they could throw a switch and secure an automatic supply of steam at moderate cost. But, moderate cost or high cost, this cannot be done except in some cities where central steam stations provide such public service. As a rule the cost of purchasing steam under such conditions is high, and is coordinated with high cost of rentals and real estate values, and the heavy cost of distribution and radiation losses.

For the average manufacturer in the country, this is out of the picture entirely. *Consequently he must make his own steam.*

Fuel and Labor

The two big items entering into the cost of steam production are fuel and labor, the rates for which are high and not coming down. A boiler can eat up its first cost in fuel in a year of operation, and a quarter or more of its costs in labor. Boiler plants 25 to 30 years old may easily consume their first cost twice a year in fuel, labor, and maintenance. The older they are, the more they eat.

Trouble is in view when the insurance company starts reducing the allowable steam pressure, and it may reach a point soon where factory production will be jeopardized.

Long before that point is reached, steps must be taken to replace the old equipment.

The efficiency of such old plants is frequently in the 40's or 50's, often in the 60's, and seldom in the 70's, as against a daily 82 to 88 per cent in a modern boiler plant.

Thus the owner can take comfort in the prospect of a large fuel saving by replacing old boilers with new ones. Good labor savings may also be made by modernization. The higher the costs of fuel and labor, the greater the return will be on such self-liquidating boiler plant improvements.

A single up-to-date boiler may readily do the work of two to four of the old-timers, some of which can perhaps be kept as reserve for a time. Thus a two- or three-step improvement program can be set up, planning in advance for the time when the ultimate plant will be completely modernized.

Immediate Savings

It is desirable to plan so that the base load can be carried by the steaming capacity of the first step. Thus most of the eventual full saving can be secured at once with only part of the total capital outlay.

So, while we all have to do things we don't care for, in this case at least substantial compensations are usually obtained.

NEW WAY All major subassemblies are timed to enter final line at point where they are to become a part of the machine. Benches are staggered so machines may be moved on special dollies from one operation to the next. This arrangement, plus the features illustrated on the following pages, has divided work so that training time is reduced from two years to two weeks

STRAIGHT-LINE PRODUCTION PAYS OFF IN FOUR WAYS

Handling cost down; efficiency, production per square foot up; and training period cut to 2 per cent of former time

CLARENCE DUNLOP • WORKS MANAGER, BURROUGHS ADDING MACHINE COMPANY, DETROIT

HANDLING costs down more than 75 per cent. Efficiency up 35 per cent, and going higher. Production increased almost 35 per cent in the same plant floor area.

These are the direct results of a new plant layout in the Detroit plant of Burroughs Adding Machine Company. The new system makes use of progressive flow principles and line assembly production methods for building typewriter-accounting machines.

Previously, the complete machine was built at individual benches by highly skilled workers. Each worker had to obtain his own materials, set up his bench, assemble the complete machine, and then deliver it to the inspection department for testing. This was cumbersome and time consuming—a very expensive and inefficient method of production. And it took two to three years to train an operator for assembly work.

A master committee was formed by plant management to study the system. The objective was to reduce costs, make work easier, and improve product quality. An actual working model was developed to enable those working on the layout to visualize methods and arrangements as they were suggested.

The final plan utilizes a "mass-production system" that embodies the following: (1) Progressive material and assembly flow; (2) line production assembly; (3) subdivision of operations; (4) balancing of operations in time allowance; (5) elimination of lifting by operators; (6) building all components away from assembly lines; (7) minimized handling between operations; and (8) standardization of product.

OLD WAY One man performed the major portion of the entire assembly operation, and had to obtain small parts for all machines from a common, central stockroom. Two men were required to move the machine from its stand and place it in storage

By subdividing the operations in the new layout, a skilled line worker can be trained in less than two weeks. Machines feed directly from bench to assembly line, eliminating the need for workers to lift the 1000-lb. machines an average of five times each.

Production can be increased or reduced easily with this new progressive flow production system. Manpower on the lines is reduced and the operation time allowance increased when production is lowered. The reverse occurs when production is increased.

Concurrent with its program of improving production methods, Burroughs embarked on a program of reducing the possible number of types of its typewriter-accounting machines.

There used to be five basic styles of this machine, each with two sets of calculating capacities having six basic calculating systems. Each of these models was further divided into 65 foreign country requirements, plus a combination of one or more features from a list of over 275 features.

There are now three basic styles, and four additional styles for fractional calculations and for pounds sterling. They are available in nine languages with 30 optional features, most of which can be added after the principal assembly operation is completed. Standardization has reduced the number of different types from over 5000 to less than a 100.

Yet these standardized machines will do virtually all the work previously done by the wider variety of models. Standardization alone made it possible to assemble sections and to erect and adjust the typewriter-accounting machine by progressive line assembly methods. These methods make possible increased production, maintenance of product quality, easier work, minimized handling, increased production efficiency, savings in plant floor area, and reduced costs.

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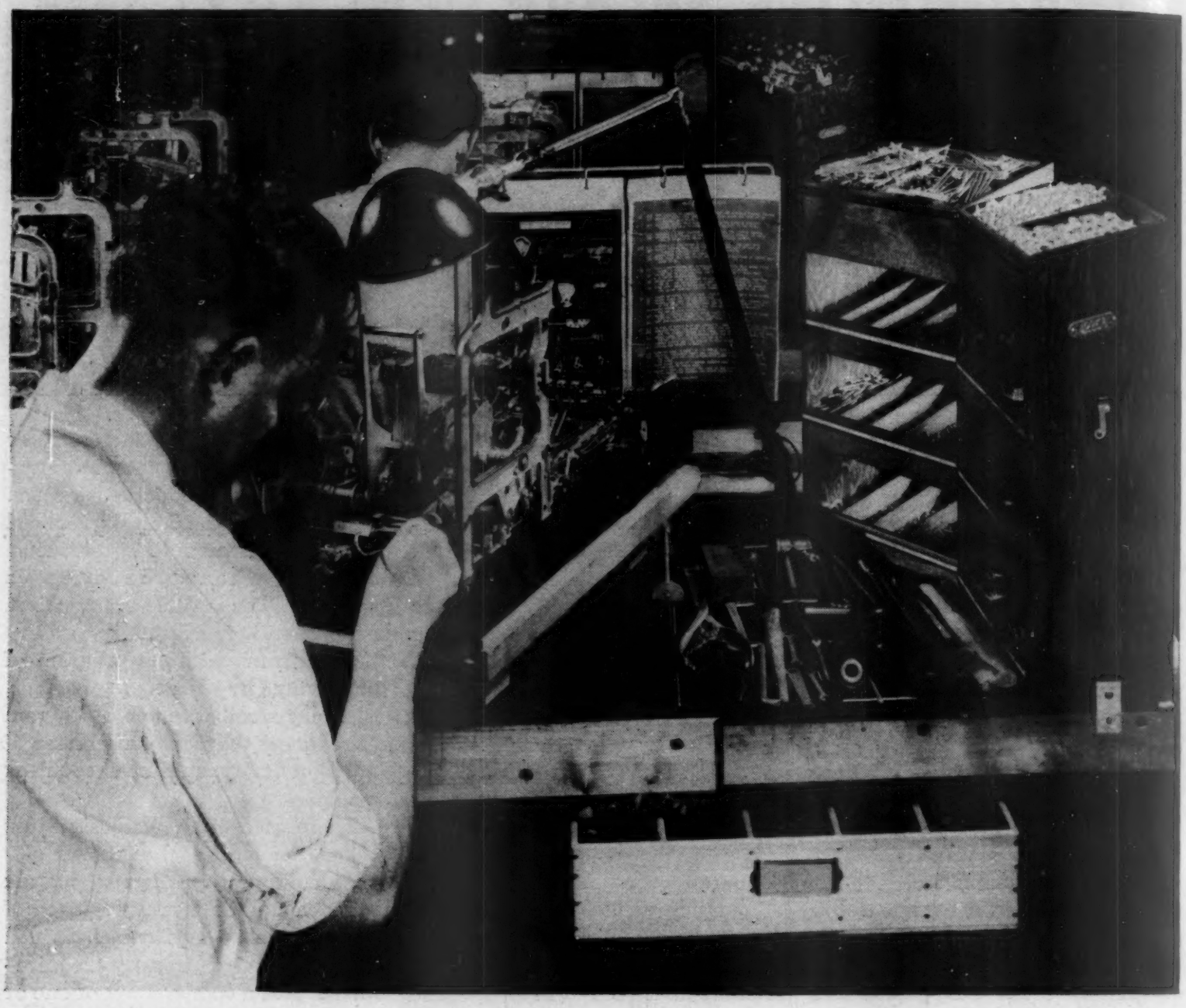
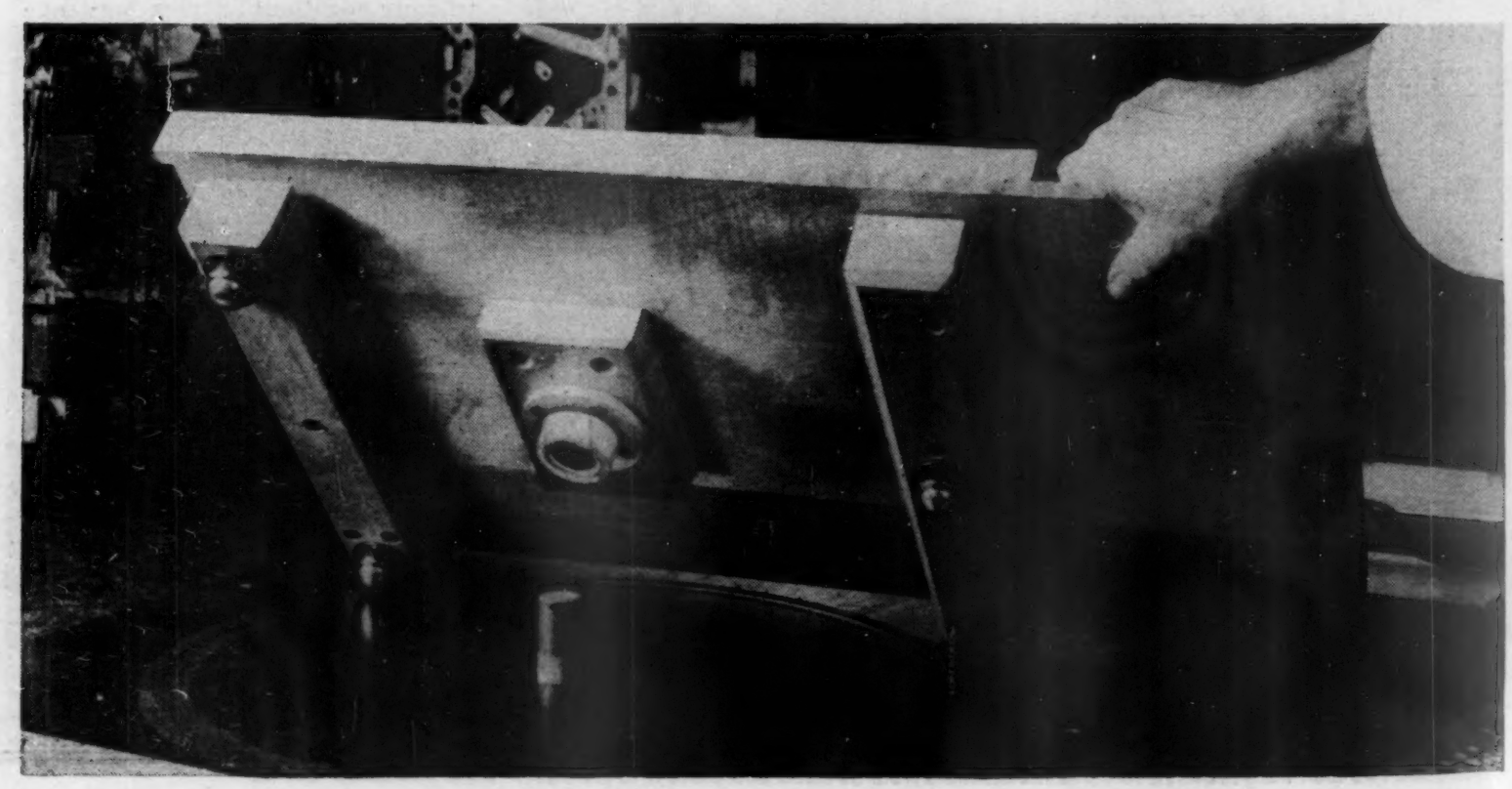
Better workplace layouts and special fixtures supplement flow-line mass



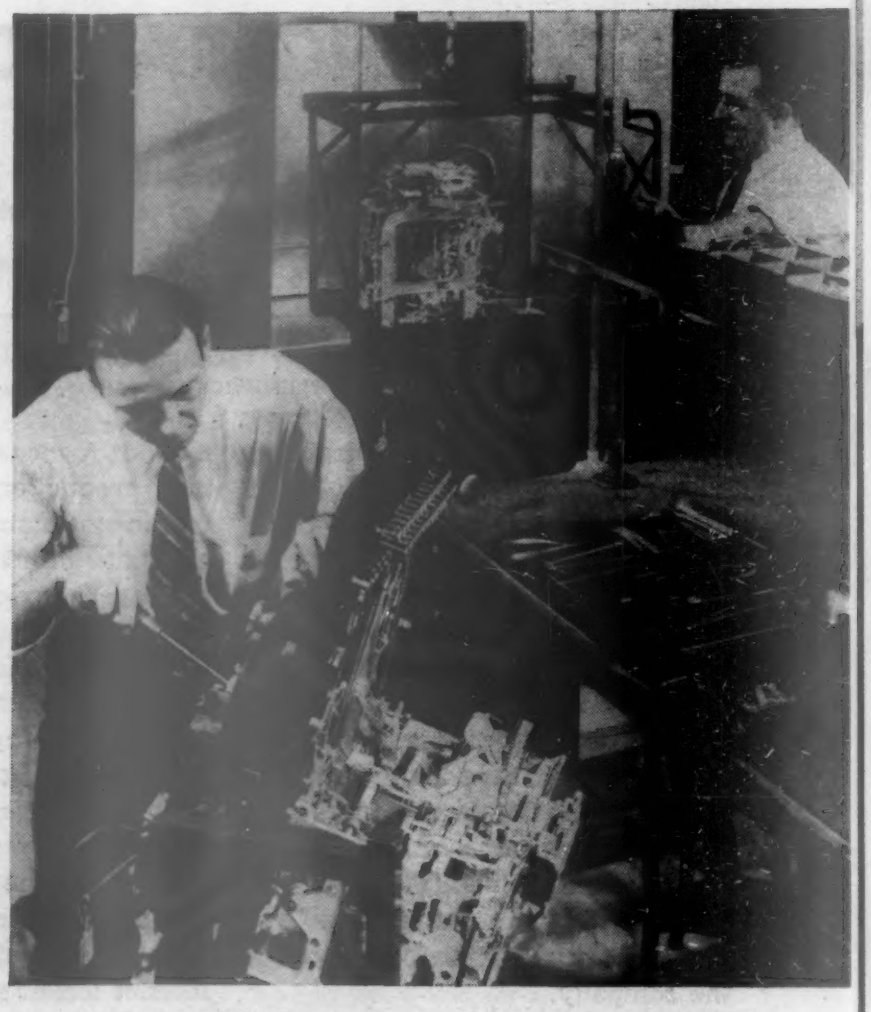
INSTRUCTIONS FOR OPERATOR are on sheets mounted directly in front of him. Match-box tray racks of parts, at right, are filled from aisle on regular schedule. Specially designed fixture-carrying machine is mounted on ball-bearing casters and attached to bench by movable center pivot (detail photograph below). It is held in position by latch which operator releases to turn machine



production techniques at Burroughs Adding Machine . . .

HYDRAULIC FIXTURE of ball-and-socket design, which permits positioning of the section it holds through entire upper hemisphere, is mounted in a recessed bench. It leaves both of operator's hands free. Stock trays are arranged to reduce area of motion

SECTIONS MOVE THROUGH SUBASSEMBLY on steel dollies. Pre-positioned, controlled torque screwdrivers speed work



MACHINES ARE OIL-SPRAYED in booth before attaching motor and typewriter. Special stands for job permit 90-deg. rotation

STAGE MONEY and pencils actually change hands as members of training group carry on transactions connected with operation of mythical pencil plant. In this way employees learn at first hand about problems of manufacturing and selling goods

TEACHING FACTORY WORKERS HOW

In January, a general outline of the Johnson & Johnson training program. Here, one of the sessions in detail

WILLIAM MACHAVER • ASSISTANT TRAINING DIRECTOR, JOHNSON & JOHNSON NEW BRUNSWICK, N. J.

As part of its employee training program, Johnson & Johnson devotes a conference to the topic "How Business Operates." Twenty production workers participate in each discussion, which is held on company time. Obviously this topic is worthy of lengthy discussion, and it is necessary to condense the subject matter into several fundamental ideas which the employees can grasp. It is necessary also to relate the discussion to their daily work so that they may understand how they are concerned in the operation of the company.

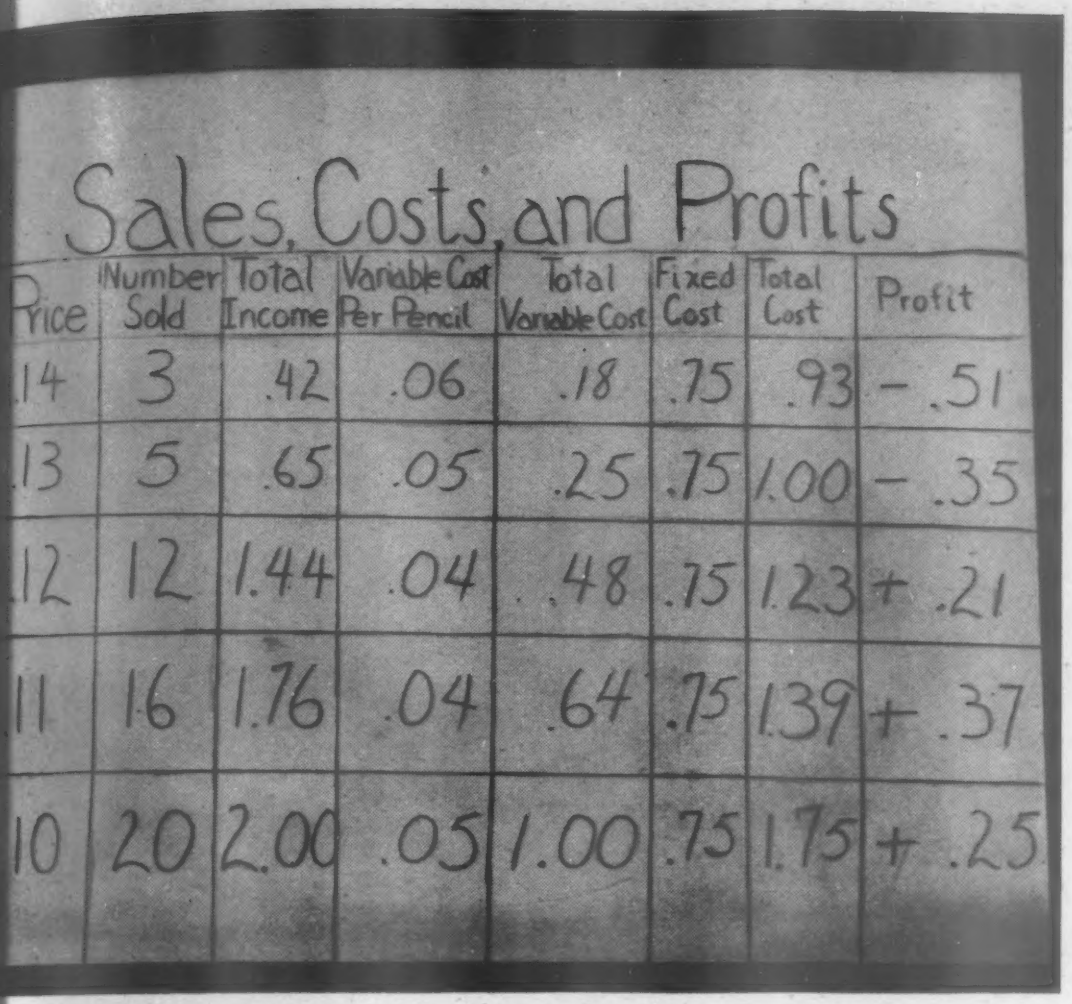
It was, therefore, decided to explain to the employees that the modern management philosophy in mass production industries is to rely on a large volume of sales to have an adequate profit over-all. Then the employees could be brought to realize that, in order to achieve this goal, it is necessary for each individual to maintain maximum production.

These concepts are taught by inviting the employees to engage actively in operating a business. In this way they are better able to understand the problems of manufacturing and selling goods.

As the start of the session the conference leader states the purpose of the meeting: To give employees an understanding of some of the problems involved in operating a business. He explains that all present are part of the company, and depend on the company for their livelihood. It is therefore to their advantage to understand how their business operates, and how they can contribute to make it a prosperous organization. The conferees are informed that during the meeting they are to feel free to offer any comments, suggestions, or criticisms they think appropriate.

A Factory of Their Own

The instructor then proposes to the group that they set up a pencil factory. He is to be the manufacturer and they the customers. When this idea is understood and accepted, money is distributed to all "customers," who are told they are free to buy a pencil when the price reaches a figure they are willing to pay. The original price is set by the



Sales, Costs, and Profits

Price	Number Sold	Total Income	Variable Cost Per Pencil	Total Variable Cost	Fixed Cost	Total Cost	Profit
14	3	.42	.06	.18	.75	.93	− .51
13	5	.65	.05	.25	.75	1.00	− .35
12	12	1.44	.04	.48	.75	1.23	+ .21
11	16	1.76	.04	.64	.75	1.39	+ .37
10	20	2.00	.05	1.00	.75	1.75	+ .25

CHART IS WORKED OUT by conferees to demonstrate relationship of sales, costs, and profits. They learn that in their "pencil plant" they make greatest profit as costs are lowered

A BUSINESS IS RUN

"manufacturer" at 14c a pencil. Perhaps three trainee-customers offer to buy at this figure. The group then works out the total income from the sale—i.e., 3 pencils times 14c equals 42c total income.

The instructor then asks the conferees to work out the cost of manufacturing three pencils. First they have to decide what factors determine the cost. The conference leader explains that costs can be grouped into broad classifications. Certain costs, such as labor and materials, change, depending on the number of workers and the amount of material used. They are called variable costs.

Other costs, such as insurance premiums, depreciation, and property taxes, remain the same. They are called fixed costs.

The instructor explains that this pencil company has assumed, for the sake of discussion, that the minimum fixed, or overhead, costs are 75c, and the variable cost for manufacturing three pencils is 6c each, or a total of 18c for three pencils. The group then adds the fixed and variable costs, and notes that the total is 93c. This figure is compared with the gross income of 42c, showing a net loss of 51c.

Price Is Too High

Everyone can see that not enough people will buy at this price to make the business profitable. More customers have to be attracted. The group suggests that the manufacturer lower the price to 13c per pencil. This is done, and again the pencils are offered for sale.

The group then determines the cost and total income—and again a loss is sustained, although a smaller one. This same procedure is followed through five price ranges—14c, 13c, 12c, 11c, and 10c. It is noted that at a selling price of 10c the number of customers does not increase significantly, and net earnings decrease (see chart at left).

The instructor then asks the group what lesson is to be learned from the experiment in which they have just participated. Several trainees suggest that in an industry such as the one under discussion it is advantageous to price products so as to promote large volume of sales.

Need for Full Production

The next point discussed is the effect of full production upon business success. Referring back to the chart, conferees note that as the number of pencils produced increases, the unit cost of manufacturing decreases. The group is asked how they account for this fact. They discover that since the fixed costs are 75c, when three pencils are produced, each one absorbs only one-third, or 25c, of this cost. When 16 pencils are produced, each one absorbs one-sixteenth of the total fixed expenses, or about 5c. This represents a substantial reduction in the cost of manufacturing, and this lowered cost is a contributing factor toward keeping prices down, which helps attract a larger market, and makes for a more stable business.

The instructor then encourages the conferees to suggest ways and means of increasing production. The group is usually quick to respond—reduction of waste; improvement of machinery; improvement of methods; better cooperation among workers; better understanding of the costs involved in each man's work. At the beginning of the meeting the trainees had agreed that the man who works on the job is in a key position to suggest techniques by which he can improve his efficiency and increase his output.

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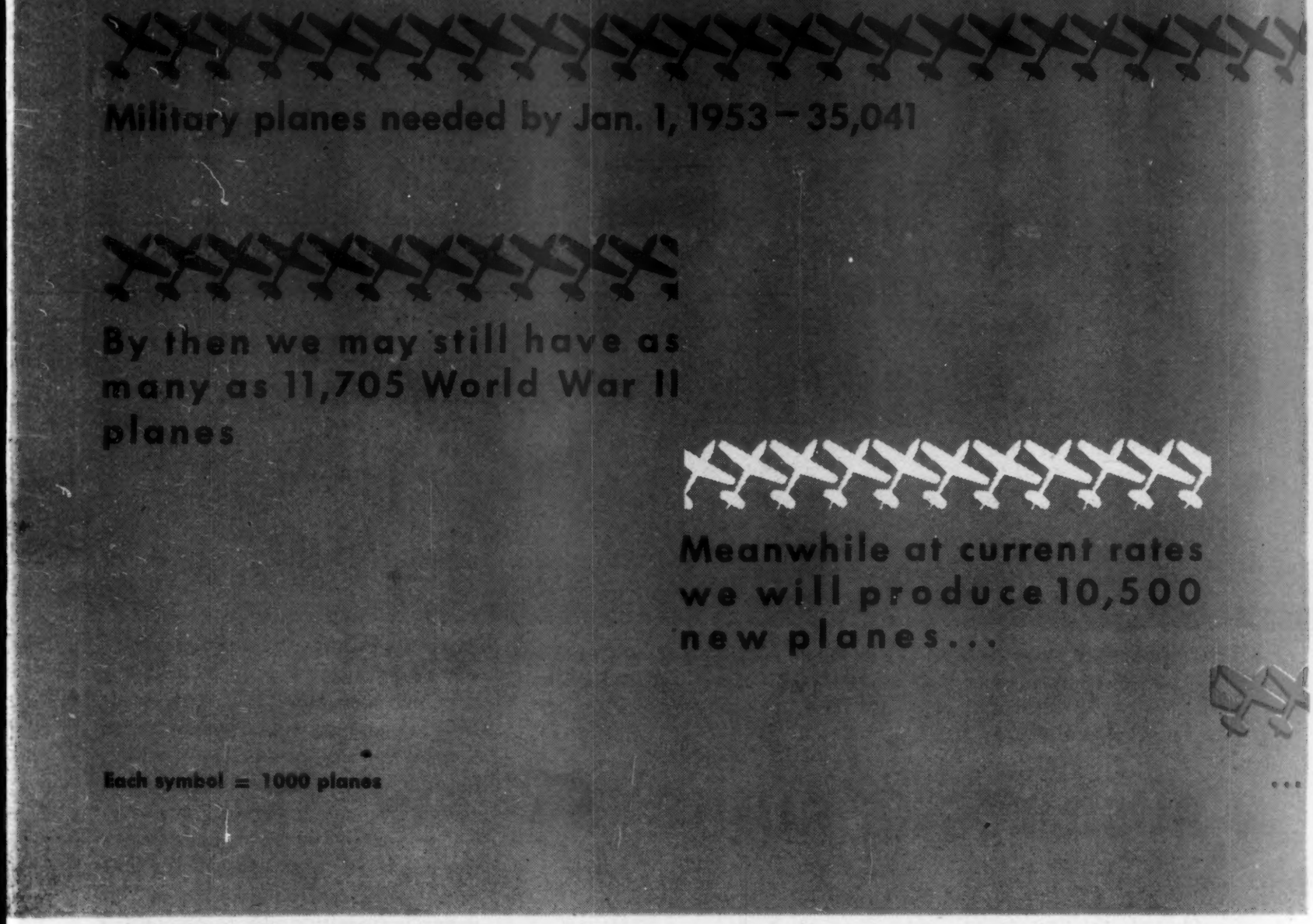
The individuals who take part in this training seem to develop a sincere interest in the problems of operating a business. They participate actively in the discussions, and, as the fundamentals described above are developed, there is general agreement that the prosperity of the company and its employees can be achieved only through mutual understanding.


PLANES WE REQUIRE vs. PLANES
Military planes needed by Jan. 1, 1953 – 35,041
By then we may still have as many as 11,705 World War II planes
Meanwhile at current rates we will produce 10,500 new planes...
Each symbol = 1000 planes

ONLY FAST WORK by Congress can change this gloomy picture, which becomes gloomier when one considers that the World War II planes in it may be usable in 1953, but are sure to be obsolete. Fortunately the chances for quick action looked bright as this

INDUSTRIAL MOBILIZATION COMMUNIQUE NO. 4

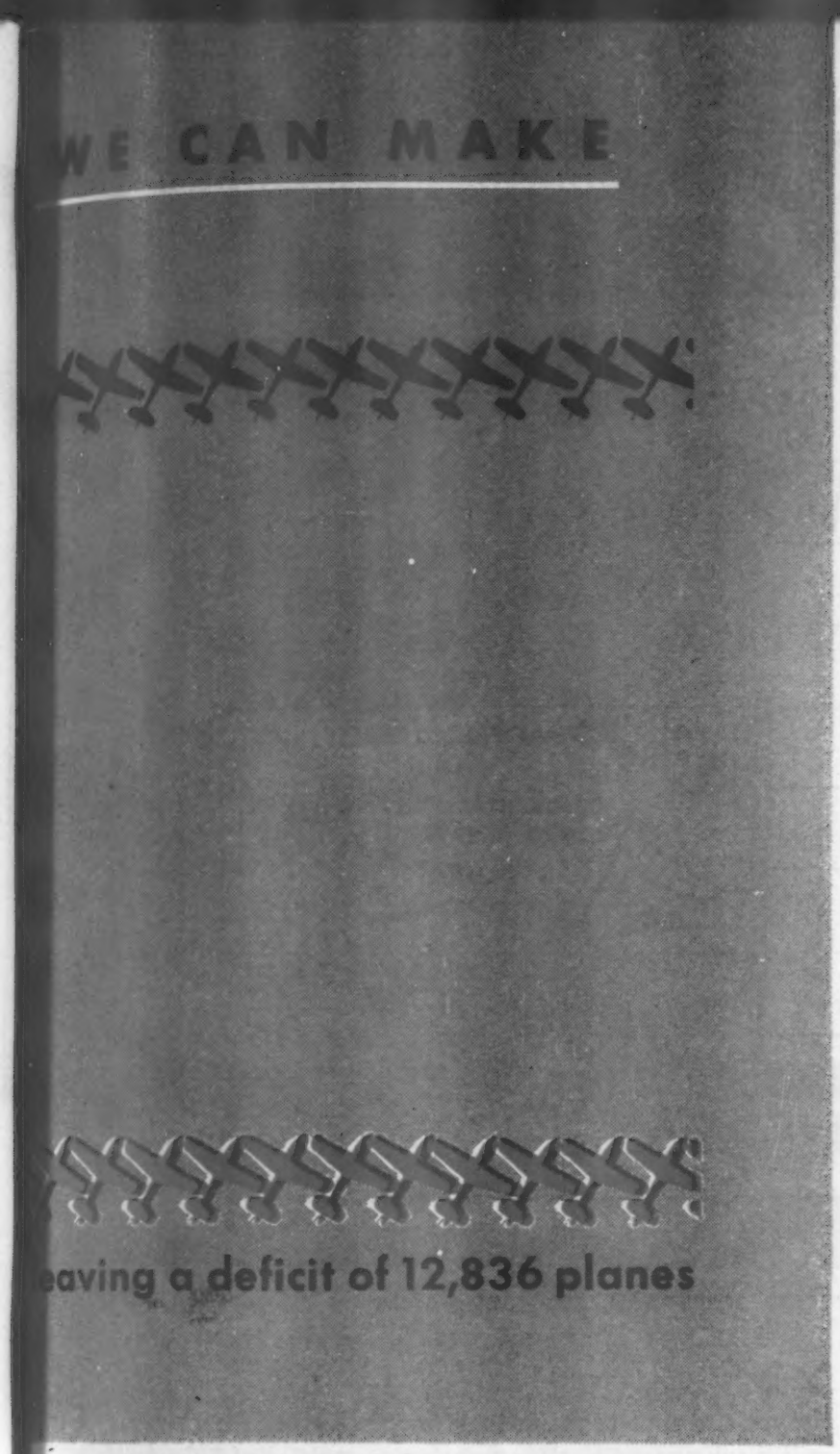
AIRPLANES NOW

▶ ***In the light of current world conditions, it is clear that the United States aircraft industry is weak. Consequently the U. S. Air Force and the Navy Air Force are weak.***

▶ ***It takes at least two years to get into mass production of fighters and bombers once they have been approved by the U. S. Air Force or the Navy.***

▶ ***To get our air power up to where it ought to be, would require more than $7,000,000,000 in 1949, and even greater amounts in 1950, 1951, and 1952.***

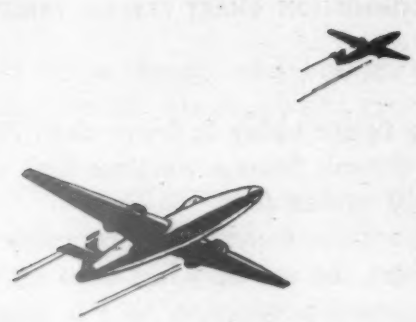
THESE are the main conclusions from a study of U. S. airpower based on reports of the President's Air Policy Commission (often referred to as the Finletter Commission) and the Congressional Aviation Policy Board.



article went to press. The House had already (April 15) approved a $3,198,100,000 measure and sent it to the Senate

AIR POWER STATUS

We need:	35,041 planes (recommended by Congressional Aviation Policy Board)
Deadline:	January 1, 1953
We can count on:	11,705 planes (World War II vintage)
We are building:	2100 planes a year (1947 rate)
We should build:	At least 5000 planes per year
Cost of program:	An estimated $5,540,000,000 this year; much more later
What we must do:	Make aircraft industry and air lines strong; appropriate adequate funds; start building planes now



FOR SECURITY

These independent groups have sifted the evidence of scores of experts. Their reports—and other developments since they were made—provide an unequaled opportunity to assess American air power in its entirety, and to find authoritative answers to three tough questions:

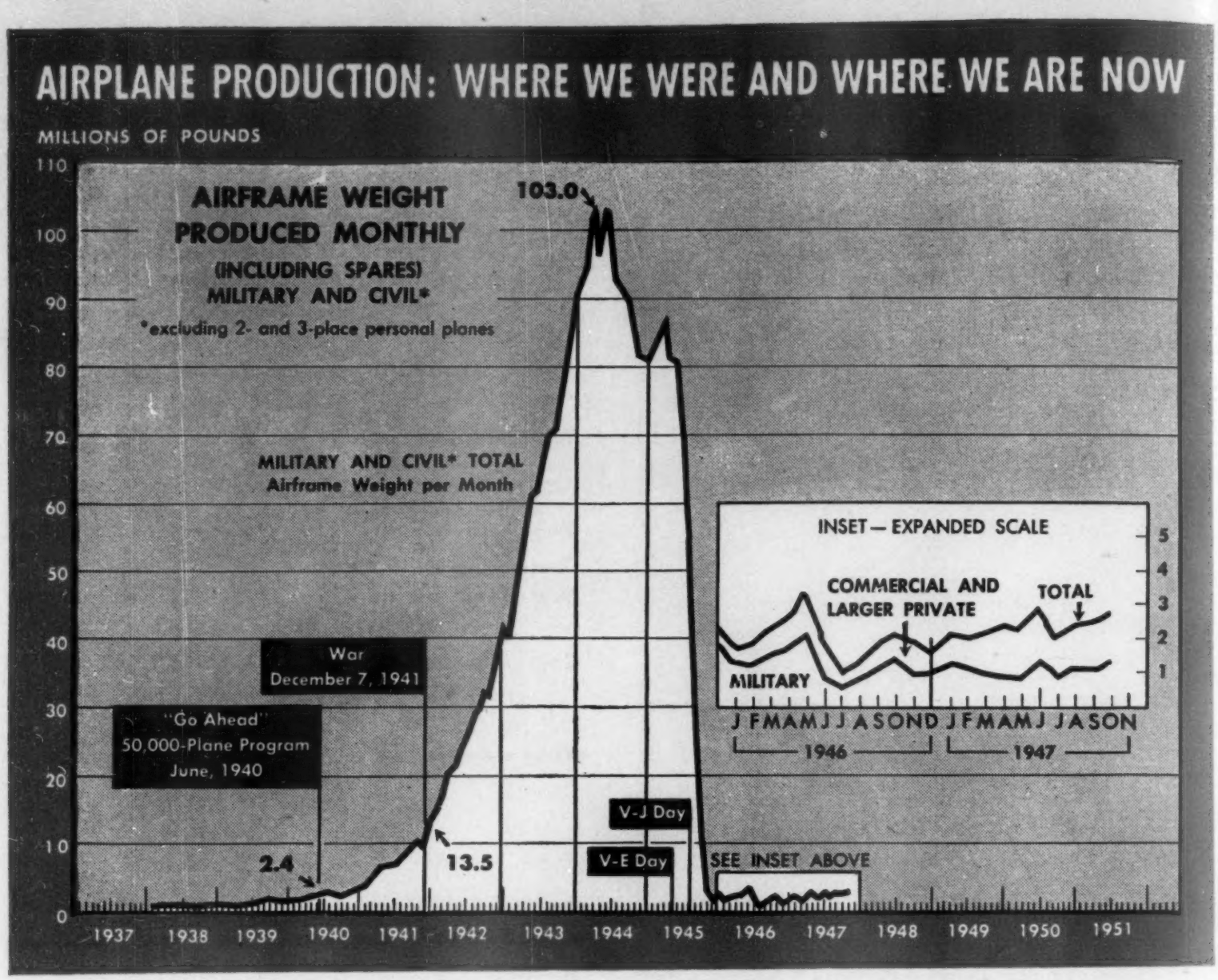
1. What are the capabilities of U. S. air power?
2. What should they be?
3. What will it take in time, men, money, and matériel to bring U. S. air power up to strength?

All three answers come to a focus on the aircraft manufacturing industry. It is so short a time since the industry was pouring out planes at the staggering rate of 100,000 per year that few people realize the changes two years of peace and an economy-minded Congress have wrought upon this wartime giant.

We Built Only 2102 Military Planes

Last year, the record shows, only 17,718 aircraft were turned out. *And a mere 2102 of these were military planes.*

The aircraft industry's employment figures tell the same grim story. At the war peak, more than 1,700,000 people were directly engaged in production. The cor-



FINLETTER COMMISSION CHART REVEALS PRESENT VOLUME OF AIRCRAFT PRODUCTION, SUGGESTS MAGNITUDE OF TASK AHEAD

responding figure today is fewer than 250,000. Plant space has shrunk from a wartime high of 175,000,000 to 53,000,000 square feet.

But figures cannot convey the complete picture. For lack of orders, the industry has been forced to change back from mass production to job shop techniques. Suppliers and subcontractors have had to turn elsewhere for business. The post-war boom in small aircraft never developed up to expectations.

In the Red to the Tune of $43,000,000

These facts add up inevitably to *hard times and heavy deficits.* Bookkeeping losses in 1946 and 1947, according to recent estimates of Glenn L. Martin, head of the company that bears his name, and Guy W. Vaughan, president of Curtiss-Wright Corporation, ran into "hundreds of millions of dollars." The blow was kept from crippling the industry, however, through carry-back provisions in the federal tax laws. Even so, manufacturers were in the red to the tune of $43,000,000 in this two-year period, with the prospect of more losses in 1948 unless the government places substantial orders. Moreover, these tax carry-backs ended last year.

In the face of these difficulties, how fast can aircraft manufacturers expand operations? If Congress approves the recommendations now before it, how long will it take to get back to fighting quantities of fighters and bombers?

The consensus of the industry is *two years, possibly more, if a start is made before further losses undermine the stability of the various companies.*

The two-year date refers to new planes already approved for purchase by the armed forces. Better ships are taking shape on the drafting boards, or are in process of being assembled and tested. They can be expected to take an additional one to three years before reaching volume production. Meanwhile, industry executives state, large numbers of conventional aircraft and guided missiles could be turned out to fill the gap.

Assets of the aircraft manufacturing industry in the expansion problem are as follows:

1. Working capital is emerging after a post-war slump and is now estimated at $550,000,000, up more than $100,000,000 from the war peak. Plane stocks are again bullish.

2. There is ample plant space available for any rate of production now contemplated.

3. Some companies could call back as many as 40 per cent of their wartime workers.

What Return to Hand Production Has Done to Output

P-47 Thunderbolt, 1943 (peak period)
1.23 man-hours per pound
2.54 pounds per square foot of floor space

P-84 Thunderjet, 1947 (85th unit)
4.68 man-hours per pound
0.25 pound per square foot of floor space

Wing Assembly (Main Jig)		
1945 P-47 Thunderbolt	102	man-hours per pound
1947 P-84 Thunderjet	385	" " "
Leading Edge		
1945 P-47 Thunderbolt	62.5	man-hours per pound
1947 P-84 Thunderjet	196	" " "
Trailing Edge — Inboard and Outboard		
1945 P-47 Thunderbolt	54.3	man-hours per pound
1947 P-84 Thunderjet	173	" " "
Wing Assembly (Final)		
1945 P-47 Thunderbolt	63.3	man-hours per pound
1947 P-84 Thunderjet	345	" " "

From testimony presented before the President's Air Policy Commission

LOW PRODUCTION MEANS HIGH UNIT COSTS. HERE IS PROOF

4. Despite two thin years, the industry has kept scientists and engineers working on a wide range of research projects. Technologically speaking, American planes are top-notch.

Balanced off against the above assets are these liabilities:

1. A concerted drive would be required to recruit the necessary number of suppliers and subcontractors, many of whom are now busy with other orders.

2. Materials would offer many a headache. The time lag between mine and fabricator averages six months at the present time. Even under war pressure some orders had to be placed nine months ahead. And current supplies are geared to low rates of production.

3. No one knows whether Congress will adopt recommendations for a long-term (5-year) aircraft procurement policy. At the moment, the chances seem slim. Thus manufacturers may have to keep on gazing into the crystal ball to figure the size of future orders from the armed forces. They must then try to estimate requirements for materials, labor, subcontracted parts, and general operations. The cost of the short-term (2-year) policy—and its effects on aircraft production—was clearly illustrated prior to Pearl Harbor, and has been dwelt upon at length by both investigating commissions.

4. Many of the management-engineer teams, which worked out and administered volume production techniques during the war, have been broken up and dissipated. Some could be recalled, but a number of new teams would have to be formed and trained.

5. Even with a backbone of war-experienced labor, large numbers of new workers would have to be recruited and trained. It is generally agreed that even in a period of high employment this could be done, but it would take months.

How the Air Lines Fit Into the Picture

Commercial aviation is another important part of the air power picture. Transport planes, airport facilities, and the trained personnel who man them, are immediately useful if war comes.

Today the United States leads the world in commercial aviation. More American planes fly more miles, carry more passengers, mail, and cargo, than those of any other nation.

But, *the air lines are losing millions doing it.*

The Congressional Aviation Policy Board makes 37 recommendations designed to correct this grave condition. The President's Air Policy Commission offers almost as many. Chief among them are the following:

1. Increased revenue for carrying mail.

2. Government aid in developing scientific methods for all-weather flying.

3. Government aid in the problem of making flying safer.

4. Increased scope, funds, and authority for the Civil Aeronautics Board, whose job has grown too big to handle.

5. More and better airports, to which federal funds would be allotted on a broader scale than the current policy permits.

6. Encouragement of over-all economies among the air lines companies.

7. Periodic reviews by the Congress relative to mail contracts, government aid, and regulation.

At Last a Unified Plan for Security

Congress is not unaware of these facts. It was handicapped until recently by the failure of the joint chiefs of staff to agree upon the roles of the Army, Navy, and Air Force. But at Key West, on March 27, they agreed upon the following unified plan:

1. Strategic air warfare is the primary responsibility of the U. S. Air Force. By corollary agreement, the Navy is free to attack any target, inland or otherwise, that may be considered necessary to the success of a naval campaign.

2. Anti-submarine patrol becomes a primary responsibility of the Navy. But the Air Force may also attack enemy shipping.

3. The U. S. Air Force takes over and maintains

air transport for all the armed forces, with a few exceptions.

4. The U. S. Marine Corps, charged with improving and perfecting amphibious landing techniques, retains such aviation components as may be required for this mission.

What the Air Force and the Navy Want

The following table shows (1) what the Air Force and the Navy want, (2) what their effective strength looked like earlier this year, and (3) number of planes in storage which can be reconditioned for combat on short notice:

1. AIR FORCE AND NAVY DEMANDS

AIR FORCE	Planes
Regular Air Force (70 groups)	6,869
Air National Guard (27 groups)	3,212
Air Reserve (34 groups)	2,360
	12,441
In reserve	8,100
Total, Air Force	20,541
NAVY	
Front-line	8,000
Support	6,500
Total, Navy	14,500*
Total, Air Force and Navy	35,041

2. PLANES IN ACTIVE SERVICE

AIR FORCE, combat	6,805
NAVY, front-line and support	4,900
Total in Active Service	11,705

3. RESERVE PLANES IN STORAGE

AIR FORCE, combat	9,184
NAVY, front-line and support	3,010
Total in Reserve	12,194
Total in Active Service and Reserve	23,899

To maintain this strength, the Air Force in 1948 has been ordering new aircraft at the rate of 13,000,000 pounds of air-frame weight annually. The corresponding figure for the Navy is 8,000,000 pounds. In addition, both forces have been drawing on reserve stocks of aircraft at a rate of 43,000,000 pounds annually—or 64,000,000 pounds of air-frame weight in all.

Once U. S. air power reached the leveling-off point (as proposed by the commissions), the maintenance rate would be 111,000,000 pounds of air-frame weight each year. This, says General Carl Spaatz, would enable the U. S. Air Force to retire one-sixth of its planes annually, or 100 per cent in six years. He regards this as the minimum safe replacement rate.

As more planes were delivered in succeeding years, the Regular Air Force would grow from the present corps of 338,000 officers and enlisted men to 401,000, and the Air National Guard and Reserve in proportion. On the other hand, the Navy would require little more personnel than it now has—but would be flying hot new planes. Because of faster landings and longer take-offs, these planes may well require larger aircraft carriers than now exist. According to Secretary Forrestal, the Navy now contemplates at least one flat-top of 80,000 tons. Such costs are not included in the estimates of either commission.

The U. S. Air Force would have 700 very heavy bombers constantly ready for combat and capable, it is expected, of hitting any target in the world from existing U. S. bases and returning again. A moderate number of replacements would be available.

Defense of the continental United States would consist of substantial forces of interceptor fighters, backed up by a complex radar warning system and "adequate ground and air defense missiles."

A 70-Group Air Force Recommended

The President's Air Policy Commission recommends—upon Air Force advice—that the 70-group organization be ready by January 1, 1950. All available new aircraft will be needed to flesh out this expansion up to that date. Then the commission advises immediate building up of the 8100-plane reserve, to be completed by December 31, 1952.

The House has swiftly approved the first step of the program by voting $3,198,100,000 for air procurement and contract authorization. Adoption of the 70-group program was protested by President Truman and Secretary Forrestal, who argued for 55 groups.

In any case, the services can expect to get less than they have asked for. Both commissions have made this plain, and for the same reason. The Congressional Aviation Policy Board used these words:

"We believe that when such a unified plan has been determined (by the Joint Chiefs of Staff) the total requirements of the Armed services may be materially reduced below the totals of the estimates prepared unilaterally."

What the Program Will Cost

The cost of air power called for by the U. S. Air Force and the Navy, added to the regular expenses of the Army and the Navy, is calculated to wring tears from the taxpayer—this year and for several years to come. The bad news, as estimated by the President's Air Policy Commission, is that the total air budget must be increased to $5,542,000,000 this year, and to $7,152,000,000 next year.

And estimates for 1950, 1951, and 1952 are higher yet. While some economies doubtless will result from implementing the Joint Chiefs' unified plan—and would thus reduce the above figures—it will be recalled that these estimates are for a considerably smaller Naval Air Force than was requested. The Navy may get more.

Add the sums to maintain the Army and Navy at present levels of strength (which the commission holds steady at just over $6,000,000,000 annually), and the awesome cost of U. S. National Defense becomes evident. The current national defense budget

*The Navy's request was passed on without alteration by the Congressional Aviation Policy Board. The President's Air Policy Commission, however, cut the figures back to the lowest point it deemed "safe"—5793 front-line planes

($10,098,000,000) would have to be revised upward for the rest of 1948 to $11,590,000,000—and the recommended national defense budget for 1949 would soar to $13,200,000,000.

The effects of such appropriations would only gradually become apparent in new air power. Fortunately, both the U. S. Air Force and Navy have substantial backlogs of war planes stored away which are expected to last until 1951-52.

The Air Force of Tomorrow

What of the future? How about the supersonic air forces, guided missiles, nuclear power for aircraft—and defense measures against them? The best information appears to be that supersonic air forces may be as much as a decade away, although the spur of war would hasten the day considerably.

Guided missiles, on the other hand, are being developed somewhat more rapidly. One of FACTORY's sources hazarded the opinion that the guided missile might succeed partially in displacing the manned aircraft about the time truly supersonic air forces became practicable. The guidance and control of missiles, he said, have been much improved since the war.

Since every new weapon invented is sooner or later countered by a defense, no doubt the answer to guided missiles will be worked out. Research to that end is going forward now—with what success officials aren't saying.

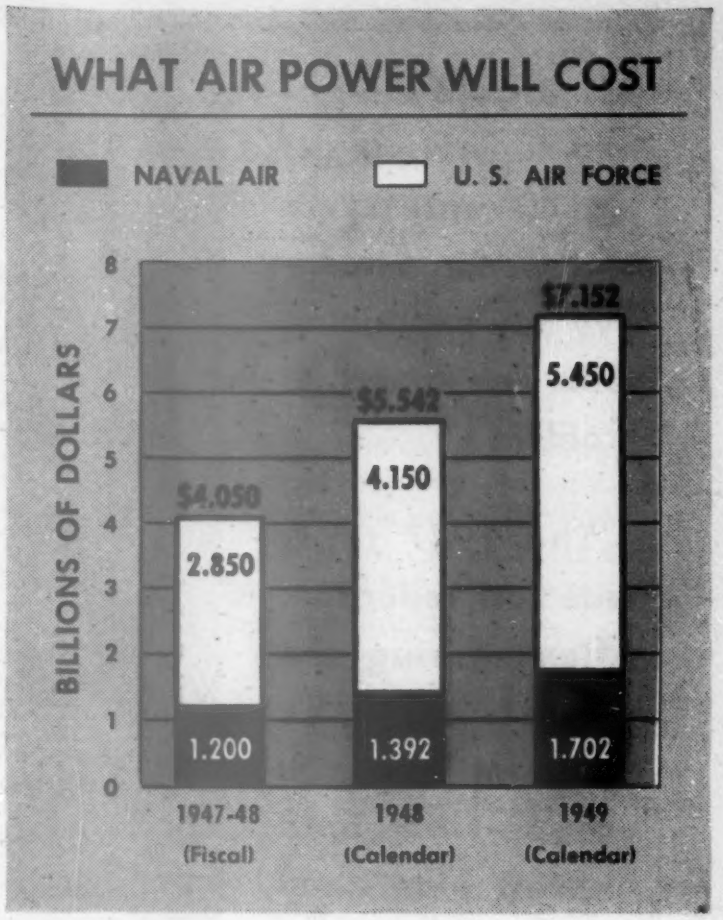
Planes That Fly Faster Than Sound

A word about air research. Two tasks are pre-eminent. The first involves designing and constructing planes that will fly faster than sound, 760 miles per hour at sea level. On the face of it, the problem sounds comparatively simple—merely apply more power. In practice, the job is complex. At 680 miles per hour, what is popularly called the "sonic wall" is encountered—an area where air "piles up" on the wings of aircraft and acts quite differently from the way it does at lower speeds. From 680 m.p.h. to something over 900 m.p.h., conventional ships take terrific punishment and strain, wind-tunnel tests show, usually enough to break them up. The problem, then, is to work out new aerodynamic formulas which will permit the plane to pass through this "sonic wall" and emerge at the other side intact.

Great progress has been made in this direction. At least one U. S. plane has pierced the lower ranges of the barrier. Probably other American aircraft have the same or better capability.

But it is obviously one thing to have a plane flash past the sonic wall and land soon afterward, and quite another to build an air force of ships able to fly long distances at sonic or supersonic speeds.

The second major research task is the development of aircraft power plants of great power—and great economy. Existing jet planes of all types are prodigal in fuel consumption. There are new jet developments that promise big economies. Further improvements will gradually correct this jet shortcoming. Moreover, as jet planes attain higher speeds, they burn less fuel. So the problem, in its simplest terms, becomes



one of getting them up to great velocity and back down again.

But the hope of all experts is the development of atomic power plants for aircraft.

The potentialities of such an invention are readily grasped. The Congressional Aviation Policy Committee considers the project immensely important and recommends that "nuclear-energy propulsion for aircraft. . . . should be accorded the highest priority in atomic energy research and development, and every needed resource and facility should be devoted to its early accomplishment."

★ ★ ★

TO SUM UP: The reports of the President's Air Policy Commission and the Congressional Aviation Policy Board make it very plain that the aircraft industry, viewed in the light of present world conditions, is woefully weak. Which means inevitably that U. S. air power, too, is weak. Our air arms are strong enough only to *defend* the United States against expected attack by weapons used in the last war. But they lack the punch to back up U. S. foreign policy or to maintain the offensive in a full-scale war.

We must therefore start building planes now on a scale big enough to enable us to reach required strength by the end of 1952. (At the rate we are going now, it would take 10 years or longer.)

We must bend every effort to go out ahead of the rest of the world by means of research.

The cost? Tremendous, of course. An estimated $7,000,000,000 in 1949. Even more in 1950, 1951, and 1952. *But the job has to be done. This country must have the planes it needs for national security, and to enforce world peace.*

All Bigelow-Sanford supervisors get together once a year and spend an intensive day examining some *one* important problem

The 1947 topic was cost reduction. After hearing the experts (see the program at right), groups from both Bigelow plants met for two hours of idea swapping

A top executive tells how it works, and what has been accomplished

PRODUCTION CONTROL CAN HELP

YOU

in your cost reduction program by

1. Reducing your *processing* costs to a minimum by consolidating orders to take advantage of set-ups. "The cost per pound is less if the batch is bigger, etc."
2. Preventing "down" time due to *"Waiting on Material"* by pre-determination of requirements and ordering and expediting delivery of the materials needed.
3. Keeping *"Allowances"* to a minimum and securing maximum utilization of service help, by full machine loading, and keeping equipment in continuous production.
4. Increasing "yields" by securing orders for special patterns, yarn blends, or weave-outs, to prevent accumulation and to develop maximum usage of waste.
5. Controlling *materials and supplies* to prevent waste, to foster standardization, to reduce capital investments, and inventory write-offs, and thus contributing to a reduction of your pro-rated *overhead charges*.
6. Advance planning, eliminating foreseeable bottlenecks, and then analyzing performance to schedule, and calling your attention to deviations, to enable you to eliminate a portion of your *Overtime* payments by prevention of major backlog accumulations.
7. Reducing *Material Handling* costs through continuous production and full, positive, and repetitive routing.
8. Determining equipment needs, through advance planning, and preventing *"Waiting for Empties."*
9. Providing free *clerical help* through consolidation of your shop clerical work with routine Production Control reports and records.
10. Reducing your charges for *Taxes & Insurance* through a smaller payroll possible through clerical consolidations, increased productivity, less overtime, etc.

COST-CUTTING CONFERENCE BRINGS

ELLIOTT I. PETERSEN • VICE-PRESIDENT FOR MANUFACTURING, BIGELOW-SANFORD CARPET COMPANY, INC., NEW YORK

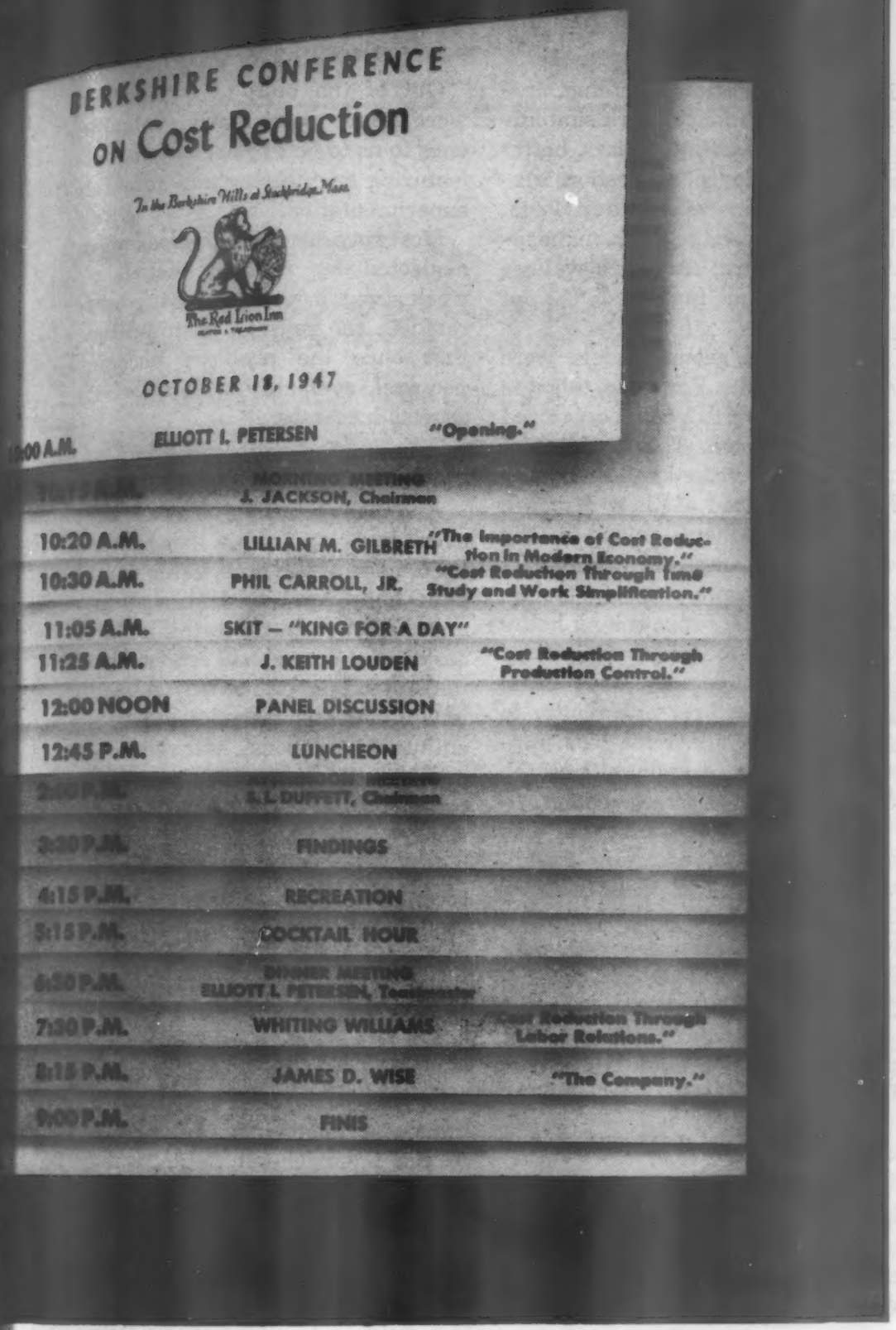
We turned the tables at the Bigelow-Sanford Carpet Company. Instead of telling our supervision how to trim costs, we asked them to give us a program of cost reduction.

In less than two hours we received more than a hundred sound suggestions. That's close to one idea per minute.

That such results were attained was gratifying to top management. Probably more important, supervision itself relished the chance to have its say.

The approach was simple. I believe any manufacturer can profit by repeating it.

At the end of the war our first objective, like many another manufacturer's, was to get back into volume production for civilian consumption. While cost was not forgotten, it was not a major consideration. More important at that time were recruitment, training of new workers, and conversion of machinery for greater production.


BERKSHIRE CONFERENCE
ON Cost Reduction
In the Berkshire Hills at Stockbridge, Mass.
The Red Lion Inn
OCTOBER 18, 1947
10:00 A.M. ELLIOTT I. PETERSEN "Opening."
J. JACKSON, Chairman
10:20 A.M. LILLIAN M. GILBRETH "The Importance of Cost Reduction in Modern Economy."
10:30 A.M. PHIL CARROLL, JR. "Cost Reduction Through Time Study and Work Simplification."
11:05 A.M. SKIT — "KING FOR A DAY"
11:25 A.M. J. KEITH LOUDEN "Cost Reduction Through Production Control."
12:00 NOON PANEL DISCUSSION
12:45 P.M. LUNCHEON
E. L. DUFFETT, Chairman
3:30 P.M. FINDINGS
4:15 P.M. RECREATION
5:15 P.M. COCKTAIL HOUR
ELLIOTT I. PETERSEN, Toastmaster
7:30 P.M. WHITING WILLIAMS Labor Relations."
8:15 P.M. JAMES D. WISE "The Company."
9:00 P.M. FINIS

OUT AN IDEA A MINUTE

Toward the close of 1946, when we could see our way clear through those primary production problems, we focused more and more attention on cost reduction. Initially, we had to train engineers to carry out basic studies to establish new standards and methods.

The broad, organized efforts were readily carried out by those who had been charged with cost reduction responsibilities.

Cost engineering departments in both of our plants, at Amsterdam, N. Y., and Thompsonville, Conn., were reorganized and expanded. Time study and rates, cost analysis, and methods sections were operating throughout 1947.

Costs Steadily Lowered

The results of this work were rapidly effective, and the costs of production in our mills steadily came down to standard, and in some instances below standard.

We knew we could carry our organized program further, and we anticipated additional reductions through improved methods of production control.

Our engineers were realistic, however. Their early experiences taught them that the foreman and the supervisor had ideas of their own on cost reduction.

We soon concluded that one way to make our cost reduction more effective was not to add additional cost engineers, but to make each of our several hundred foremen a cost reduction thinker.

The old methods of cost reduction were simple. All you did was to go out in the plant and cut rates, or you went out and cut quality, or you went out and drove labor to greater efforts under the threat of being fired.

Those methods are all gone. Today, ways and means of reducing costs are waste saving, improved materials handling, improved maintenance, work simplification, labor-saving devices, better quality, incentives, better union relationships, better teamwork, improved plant facilities. *On all these ways supervision has an impact.*

One-Day Conference

A year ago Bigelow inaugurated a one-day conference in the Berkshires, half-way point between our two plants. This meeting gave supervision from both plants a chance to mingle and discuss common problems. The conference also was set up to give management an opportunity to talk with all its supervision as a group.

With the second of these annual sessions approaching in October, 1947, the subject "cost reduction" was chosen for the session.

We set out to seek from discussion sessions at the conference the ideas our supervisors might have on cost reduction.

We told them:

"We are not too interested in generalities. We are interested in specific recommendations which might be applied. Not to be forgotten today, not to be put aside in the book and filed away and forgotten, but that we can apply and put into

effect as soon as we return to our jobs next week.

"Therefore, we are running this conference on a basis of participation, because we believe if anybody can give any ideas, or has any ideas, about cost reduction, it is the fellow who is handling these costs every day, and that is the supervisor."

Supervisors and foremen spent the morning listening to the experts—Dr. Lillian M. Gilbreth, Phil Carroll, Jr., and J. Keith Louden. And in the evening they heard Whiting Williams on labor relations, and the president of their company, James DeCamp Wise, on the future outlook.

Afternoon Session

But the heart of the conference was the afternoon session, in which supervisors threshed out their own problems.

The printed program notes put it this way:

"He Helps Who Helps Himself"

"You've listened now to the people who really know. You have had your own experiences and you have some ideas, too, on how to go about this drive to *reduce costs.*

"Let's trade. Put your ideas on the table. Let's develop them and see how far they'll lead us. The other fellow has some good ones too.

"Remember your conference group number? Go to the room number indicated and really take part in the discussion. In helping yourself, you'll be helping others."

Group discussions centered around twelve topics—cost reduction through waste saving, improved materials handling, improved maintenance, work simplification, labor-saving devices, better quality, employee suggestion systems, non-financial incentives, better union relationships, management teamwork, employee welfare programs, and improved use of plant facilities.

The twelve group leaders were superintendents. For some, this was their first effort to lead an organized group discussion. The facilities of the training division of the company had been placed at their disposal, and all of them—prior to the conference—completed voluntarily a course in conference leadership. In addition, they spent many hours of their own time preparing for this leadership assignment. They came prepared, therefore, with ability to get others to talk. *Each was purposely assigned a topic with which he had the least direct contact.*

After an hour and a half of discussion the twelve groups reconvened and reported their findings. These reports not only surprised and pleased top management, they also surprised and pleased the supervisors themselves.

The forums were productive not only of cost reduction ideas, but they also brought out other results.

A Successful Meeting

The morale of supervision was boosted. The value of participation, rated high by management, now has an even higher rating. The meetings were marked with enthusiasm, and with an individual desire and willingness to participate.

Supervisors agreed that the sessions in which they themselves participated were the best of the conference. Their only criticism was that the panel forums were too short, that more ideas could have been brought out if they had had time for additional discussion.

At this time it is too early to assay more concrete results in terms of actual cost reduction. The reports of each group, however, have been digested and specific ideas extracted for a program of action which is being instituted wherever it applies.

Management noted also that of the suggestions received some were broad in their implications, others specific, precise.

Out of the bulk of suggestions were some particularly valuable ones to us to be explored by manufacturing engineering and research experimentation.

Most surprising of all, ideas often neglected by foremen — such as work simplification—were incorporated in the reports, an indication that once the problem becomes *personal,* sympathy with all of its aspects increases.

Future Results

And management was aware that even had no usable suggestions been made at the time, value would have been received because foremen had been made to think about cost reduction and had reached new understanding of it. We feel sure today that our foremen are more enthusiastic about management's problems in cost reduction; more conscious of it in their departmental work.

One of the most important results of the conference is the acceptance by top management of a plan for continuing to receive foremen and supervision's suggestions.

Prior to the Berkshire Conference, Bigelow management had been studying all the various means others have proposed for increasing industrial democracy, particularly in the management field. It may well be this study which prompted us to set up our cost reduction conference in the first place.

One of our forum groups proposed a supervisory executive board on production and procedure problems. We have combined this suggestion with the previous thinking along similar lines to come up with the plan now being instituted for supervisory participation in management policies.

We are now setting up foremen and superintendent boards to discuss and recommend ideas for production improvement. We believe that they will work as effectively as did our Berkshire Conference as a means of giving voice to ideas from those strata of management.

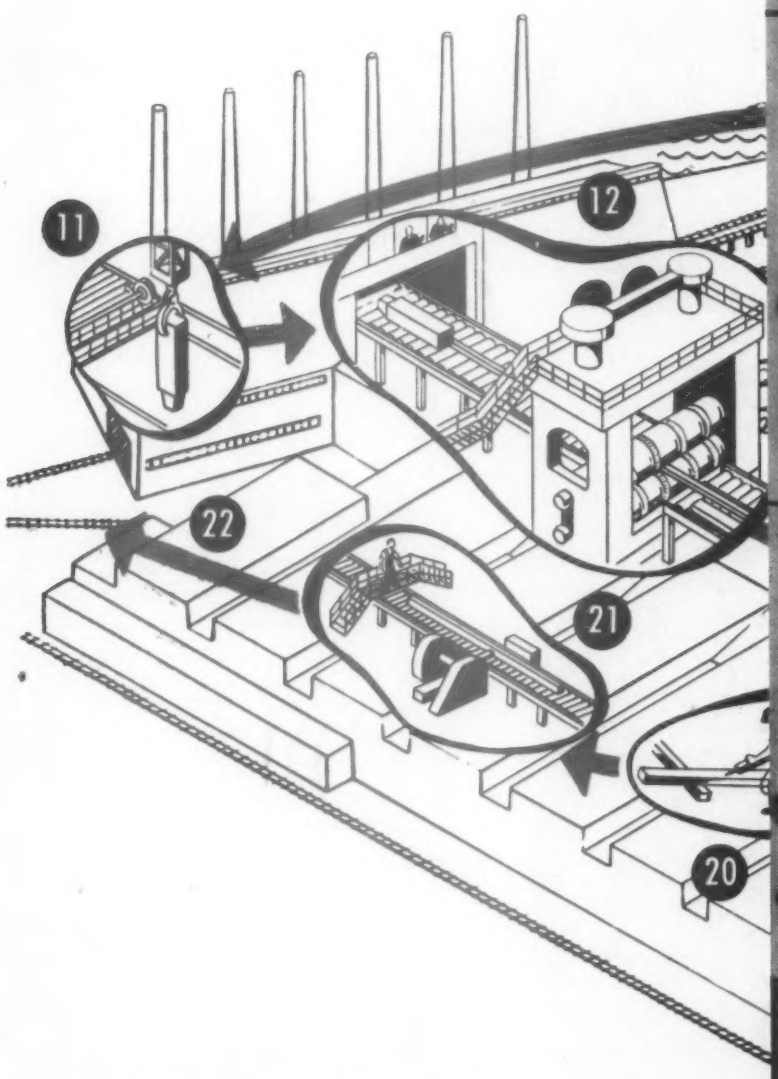
We opened the door to a new flow of information at Bigelow. The flood of workable, pointed ideas that resulted will go a long way toward helping us achieve our goals—and maintain them—in cost reduction.

Every Month . . .

AMONG THE ADVERTISING PAGES, these valuable aids to low-cost production: the plant operation man's guide to **WHAT'S NEW IN EQUIPMENT** (page 142) . . . a summary of **LABOR DEVELOPMENTS** (page 226) . . . things **YOU WANT TO KNOW** more about (page 216)

4. ELECTRIC FURNACE STEEL

REPUBLIC STEEL CORPORATION, SOUTH CHICAGO, ILL.



THE processes used in converting iron ore to electric furnace steel can be followed by the arrows in the diagram of Republic's Chicago plant. This completely integrated steel plant is the only one of its kind in the country designed wholly for the production of electric furnace steels.

Included are a 1275-ton blast furnace complete with river dock, ore yard, sinter plant, and power house; 75 coke ovens with a complete by-product plant; four 200-ton tilting-type open hearth furnaces and nine 70-ton electric furnaces housed in one building to facilitate a double refining operation; a 44-in. blooming mill and a 36-in. roughing-32-in. finishing bar mill with all the necessary slow cooling, cold sawing, pickling, chipping, straightening, heat-treating, and shipping facilities; and finally the metallurgical and chemical laboratories, gatehouse, administration building, service shops, and other auxiliary buildings.

Principal steps in the conversion of iron ore to electric furnace steel bars follow (numerals correspond with those on flow chart):

1. Raw materials—coal, limestone, and iron ore—unloaded and stored.

2. Blast furnace—iron ore reduced to pig iron.

3. Bottle car—molten pig iron to open hearth furnace.

4. Scrap, fluxes, and alloy additions delivered to stockhouse and open hearth buildings.

5. Stockhouse—scrap, limestone, and alloy additions stored and loaded to charging pans.

6. Open hearth furnace—steel scrap and pig iron refined to steel.

7. Electric furnace—scrap and open hearth steel refined to high-quality steel.

8. Molten steel poured into ingot molds.

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12. Bloomir
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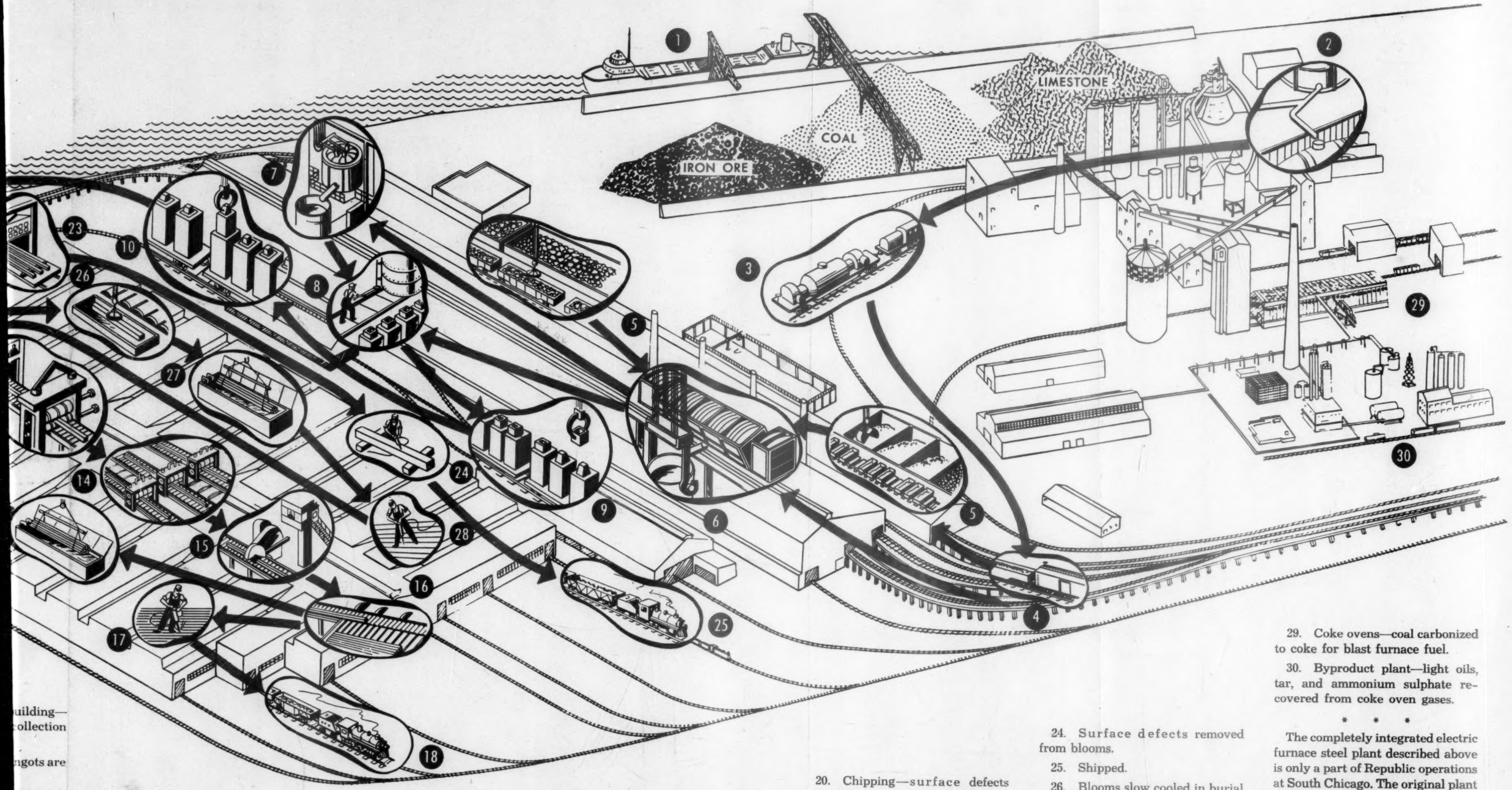

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13. Roughing mill—blooms rolled into billets.

14. Bar mills—billets rolled into semi-finished shapes.

15. Hot saw—billets cut to length.

16. Cooling beds—billets cooled to handling temperatures.

17. Scarfing—surface defects removed by acetylene torch.

18. Shipping.

19. Pickling—acid dip reveals minute surface defects.

20. Chipping—surface defects removed by pneumatic chisel.

21. Straightening—billets and bars straightened before shipment.

22. Shipping.

23. Blooms slow cooled in furnace.

24. Surface defects removed from blooms.

25. Shipped.

26. Blooms slow cooled in burial pits.

27. Acid dip reveals minute surface defects.

28. Surface defects removed by acetylene torch; blooms returned for reheating and rolling.

29. Coke ovens—coal carbonized to coke for blast furnace fuel.

30. Byproduct plant—light oils, tar, and ammonium sulphate recovered from coke oven gases.

* * *

The completely integrated electric furnace steel plant described above is only a part of Republic operations at South Chicago. The original plant consists of open hearths, blooming mill, billet mill, 10-in. bar and rod mill and 12-in. merchant mill, and a large wire mill. It produces all types of bars, rods, special sections, wire, nails, fence, barbed wire, and other miscellaneous wire products.

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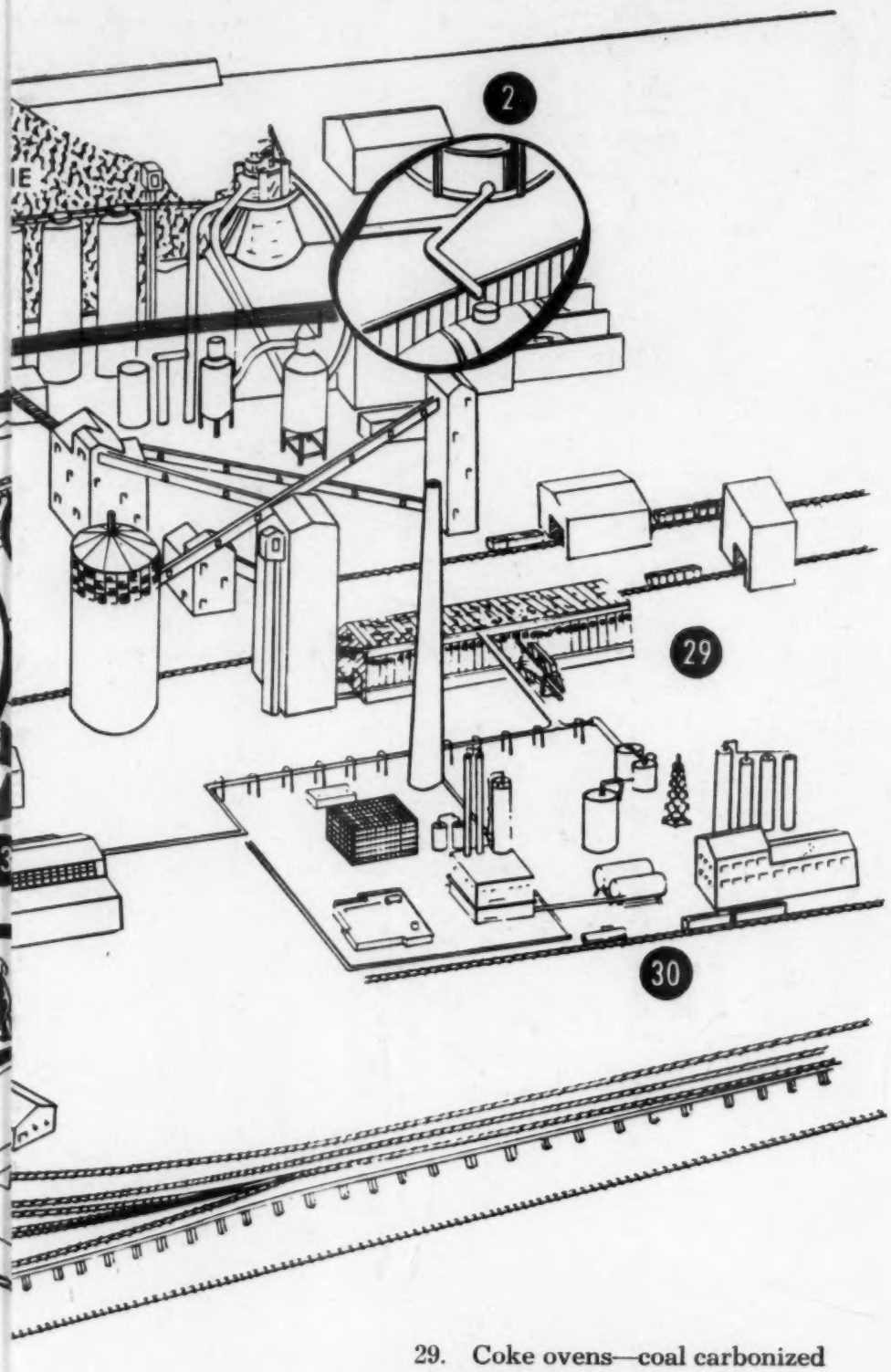

29. Coke ovens—coal carbonized to coke for blast furnace fuel.

30. Byproduct plant—light oils, tar, and ammonium sulphate recovered from coke oven gases.

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WHAT ELECTRIC DISTRIBUTION SYSTEM FOR YOUR PLANT

Seven major systems: What they are. What they do. How they compare. Told here so plant operating men can be sure they get the system that best fits present and future needs

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JOHN S. PARSONS • DISTRIBUTION ENGINEER, WESTINGHOUSE ELECTRIC CORPORATION, PITTSBURGH

CTORY MANAGEMENT AND MAINTENANCE • Plant Operation Library No. 111 • May, 1948
pyright 1948 by McGraw-Hill Publishing Company, Inc. 330 West 42nd Street New York 18, N. Y.

ELECTRIC POWER DISTRIBUTION: *Part I.* The seven major systems, with an analysis of the technical features, strengths, and weaknesses of each

● The function of the electric power distribution system in an industrial plant is to receive power at one or more bulk power supply points and deliver it to the individual lamps, motors, and all other electrically operated devices. The importance of the distribution system makes it almost imperative that the best system be selected and installed.

The best distribution system for a plant is the one that will most economically and safely supply adequate electric service to both the present and the probable future plant loads. In order to select and design the best distribution system for a plant an intimate knowledge of the loads to be served is necessary. The magnitudes, locations, characteristics, and importance of the plant loads, plus the probability of future load changes, are the chief factors influencing choice of system.

Loads differ widely in different plants, and in different parts of the same plant. Hence there is no one type of distribution system that can be used to serve properly all industrial plants, or all parts of very large plants.

There are seven major types of industrial plant distribution systems:

1. Simple radial.
2. Loop primary radial.
3. Banked secondary radial.
4. Primary selective radial.
5. Secondary selective radial.
6. Simple network.
7. Primary selective network.

In addition there are certain common modifications of some of these systems. They also are considered in the discussion which follows.

1. SIMPLE RADIAL SYSTEM

Perhaps the best known industrial plant distribution system is a form of the simple radial system, often referred to as the conventional radial system. Until a few years ago it was generally used in industrial plants. This system uses a single substation where power is received at the supply voltage and stepped down to the utilization voltage. Power is supplied to the low-voltage bus in the substation through a transformer bank, or two or more banks in parallel.

Low-voltage feeders are run from the substation to the various load centers in the plant, as in **Figure 1.** Each feeder is connected to the substation bus through a circuit breaker. At the load center end of each feeder the power is distributed through switchgear over smaller load circuits, either directly or through panelboards to the motors, lights, and other loads.

The entire plant load is fed through a single substation and from a single low-voltage bus; therefore full advantage is taken of the diversity among load centers. This permits using the minimum amount of transformer capacity.

Since all power is distributed at utilization voltage from a single point, voltage regulation and efficiency are poor. Cost of load feeders and their circuit breakers at the substation is excessive, except with small plants where the distances are short and the total load is about 1000 kva. or less.

A fault on the substation bus, or in most cases in a substation transformer, will interrupt service to all loads. A fault on any feeder from the substation to a load center causes an outage to all loads supplied from that load bus.

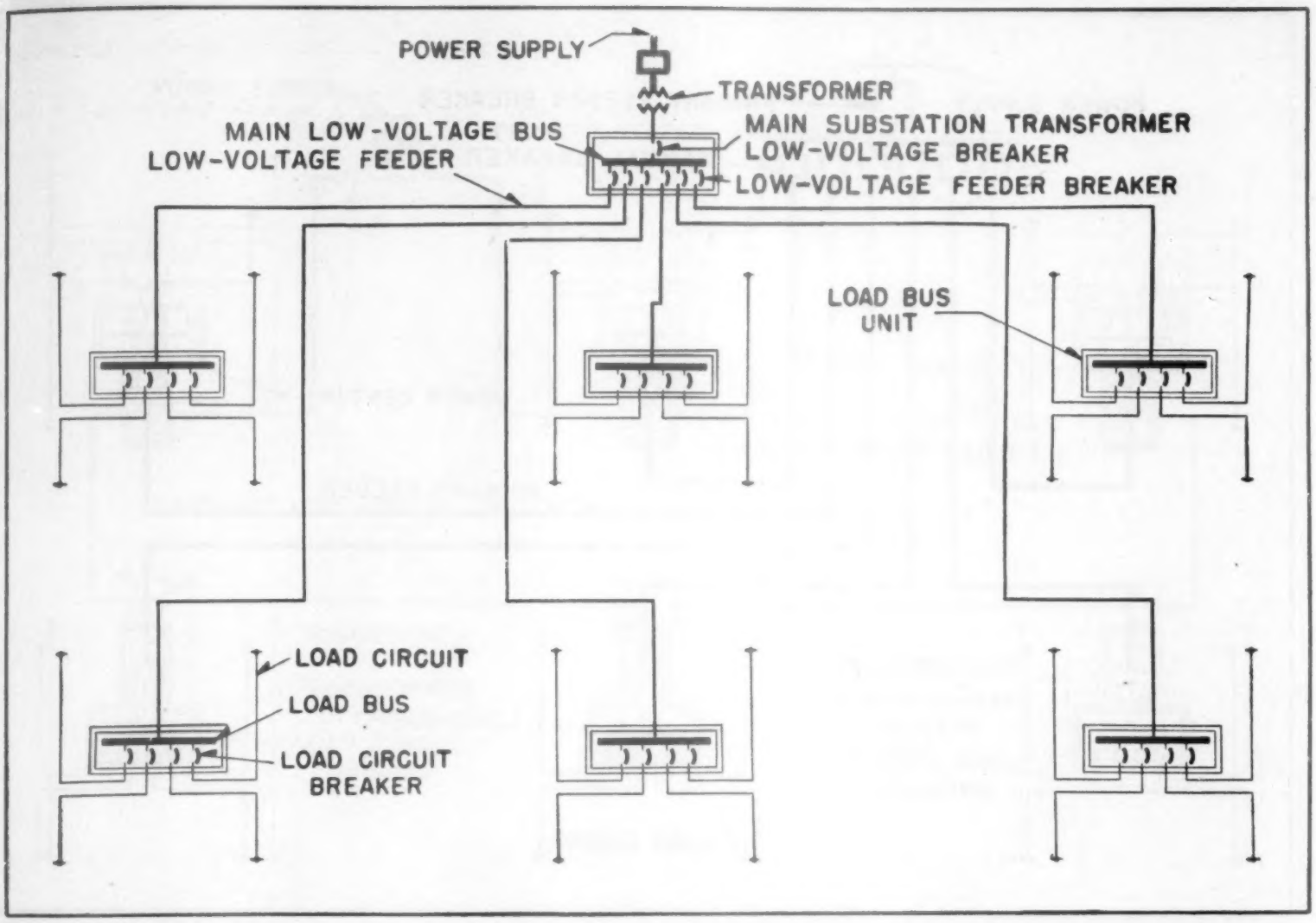
The modern version of this system overcomes many of the objections to its predecessor by distributing power to the various load centers at a distribution voltage, rather than the much lower utilization voltage. At each load center the distribution voltage, which is often the power supply voltage, is stepped down through a relatively small transformer. The transformer is connected to the load bus usually through a breaker, as shown in **Figure 1A.**

Load circuits radiate from the load bus through circuit breakers. Hence there is a small secondary substation located at or near each load center. These secondary substations usually take the form of factory-built unit substations. Each consists of a three-phase liquid or air-cooled transformer, with a primary switch mounted integral with it, and draw-out type, low-voltage metal-clad switchgear. Transformer and switchgear are bolted together to form the unit substation.

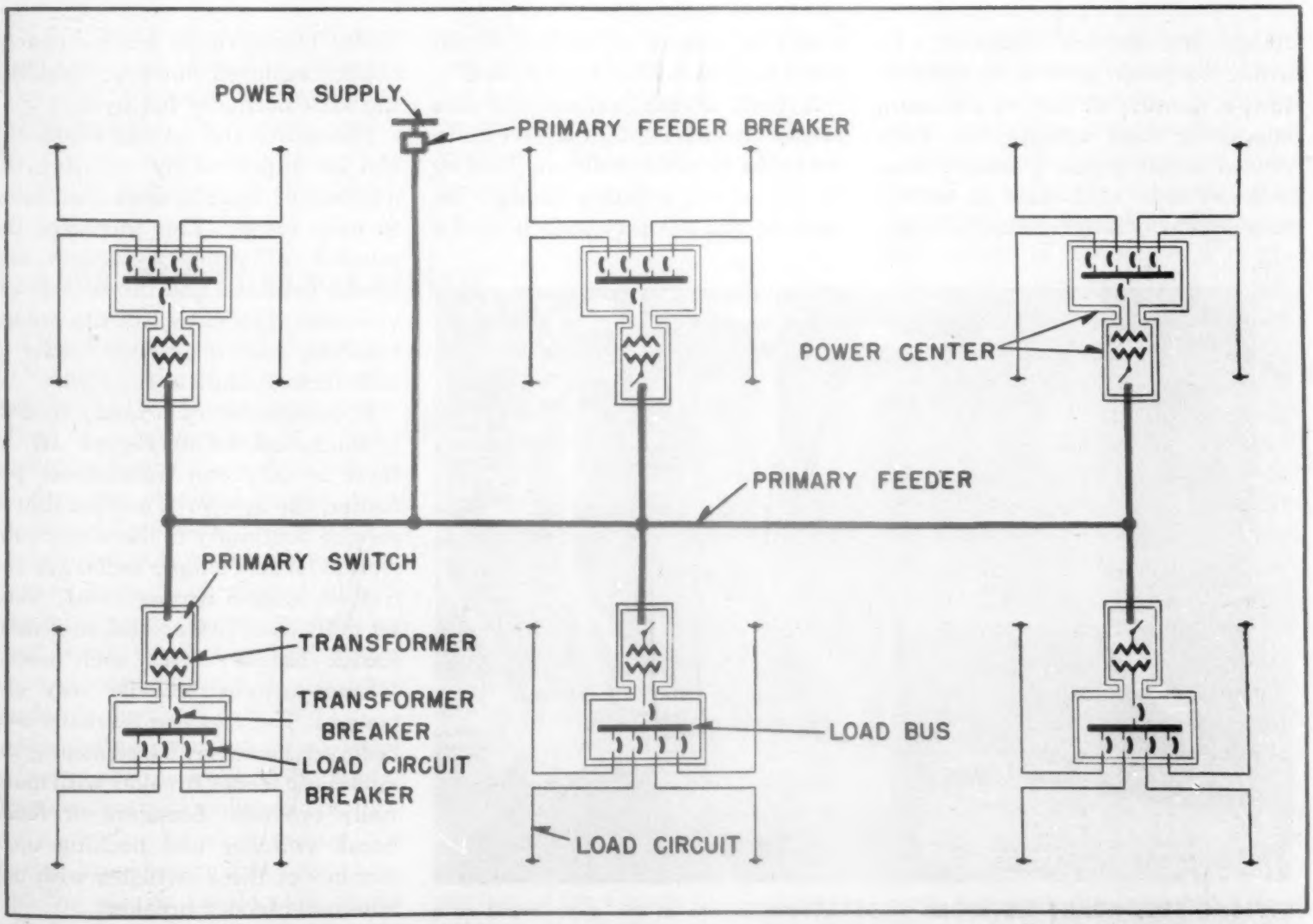
Since a transformer is located at each load center it must have sufficient capacity to carry the peak load of its area. Hence, more transformer capacity is required, if there is any diversity among load center areas, than in the conventional form of simple radial system. However, because power is distributed at high voltage, losses are reduced, regulation is improved, there is a marked saving in feeder circuit copper, and the large low-voltage feeder breakers are eliminated. Also, the interrupting duty on the load circuit breaker is more uniform, and at many load centers is less than when using a system with one large substation.

The modern form of simple radial system, Figure 1A, will usually be lower in initial investment than any other type of distribution system for plants having a peak load above about 1000 kva. It is very poor, however, from the standpoints of flex-

PHOTOGRAPH ON PRECEDING PAGE• This 1000-kva. substation supplies low-voltage power for Weirton Steel Company's new tandem cold reduction tinplate mill



1. SIMPLE RADIAL SYSTEM. COST EXCESSIVE EXCEPT IN SMALL PLANTS WITH SHORT DISTANCES, LOAD BELOW 1000 KVA.



1A. SIMPLE RADIAL (MODERN). POOR FLEXIBILITY, CONTINUITY; LOWEST INITIAL COST IF PEAK LOAD ABOVE 1000 KVA.

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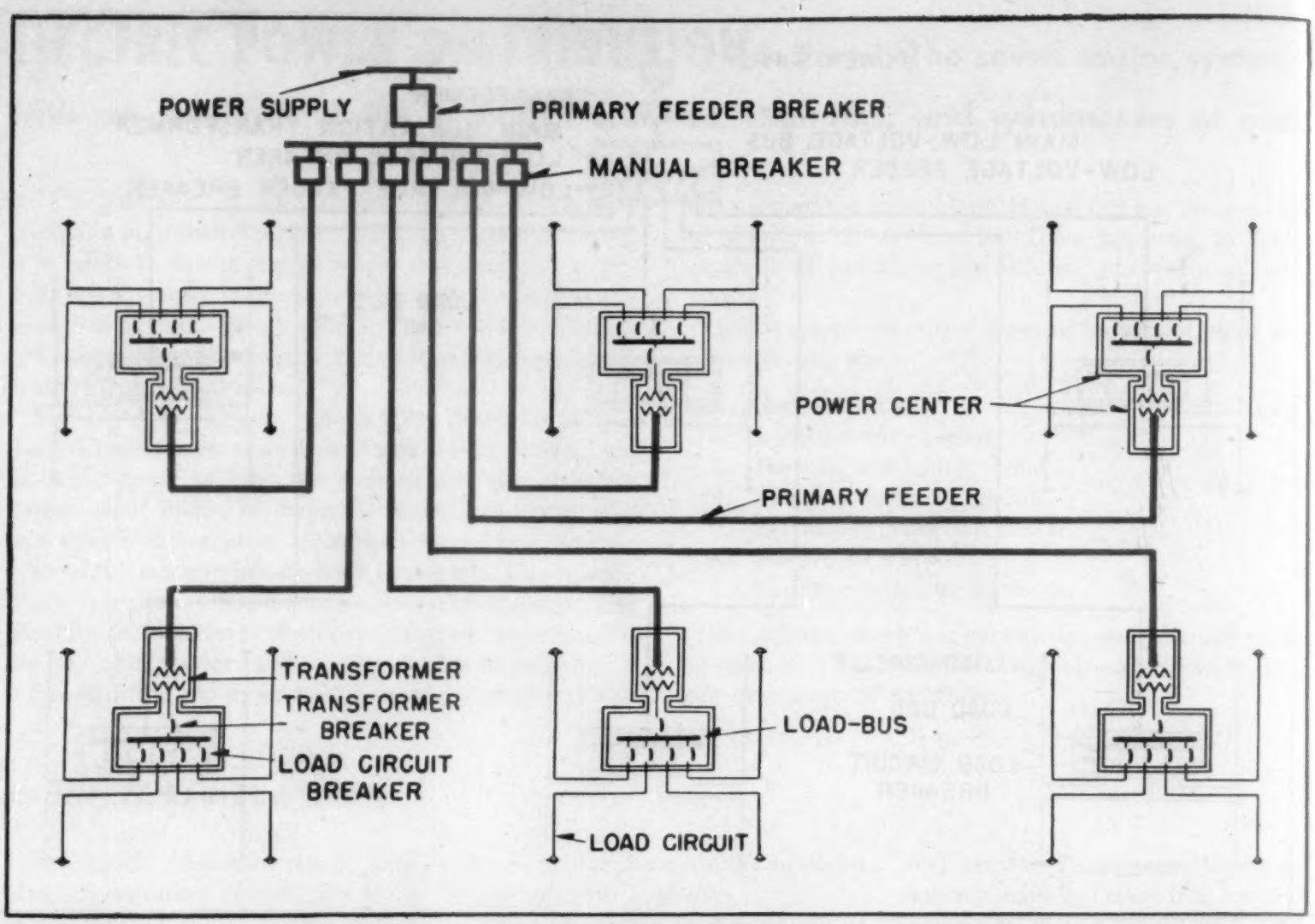
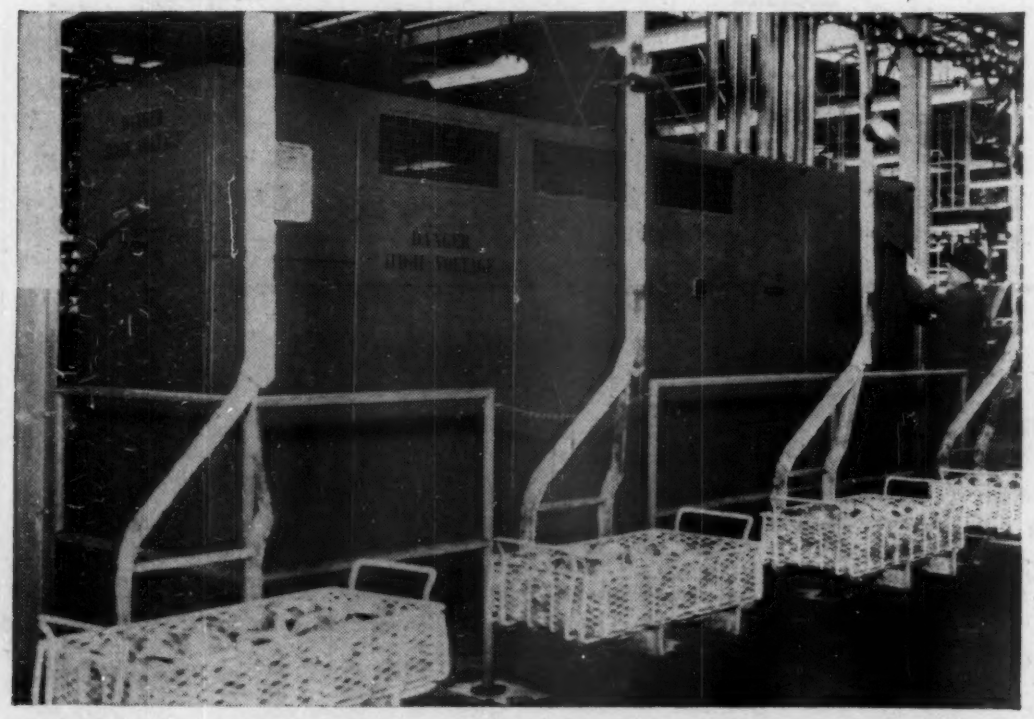


1B. SIMPLE RADIAL (MODERN, MODIFIED). ADDED PRIMARY FEEDERS RAISE COST ABOVE 1A BUT IMPROVE SERVICE CONTINUITY

ibility and service continuity. In order to keep system investment low, a number of the transformers supplying load centers are connected to one primary feeder. Thus a feeder fault will cause an outage to a relatively large amount of load, which in a small or medium-sized plant may be half or all the load.

A fault in one transformer also causes an interruption of service to the entire area normally supplied by its associated primary feeder. By opening the primary switch of the faulty transformer, service can be quickly restored, however, to all but the area normally fed by it.

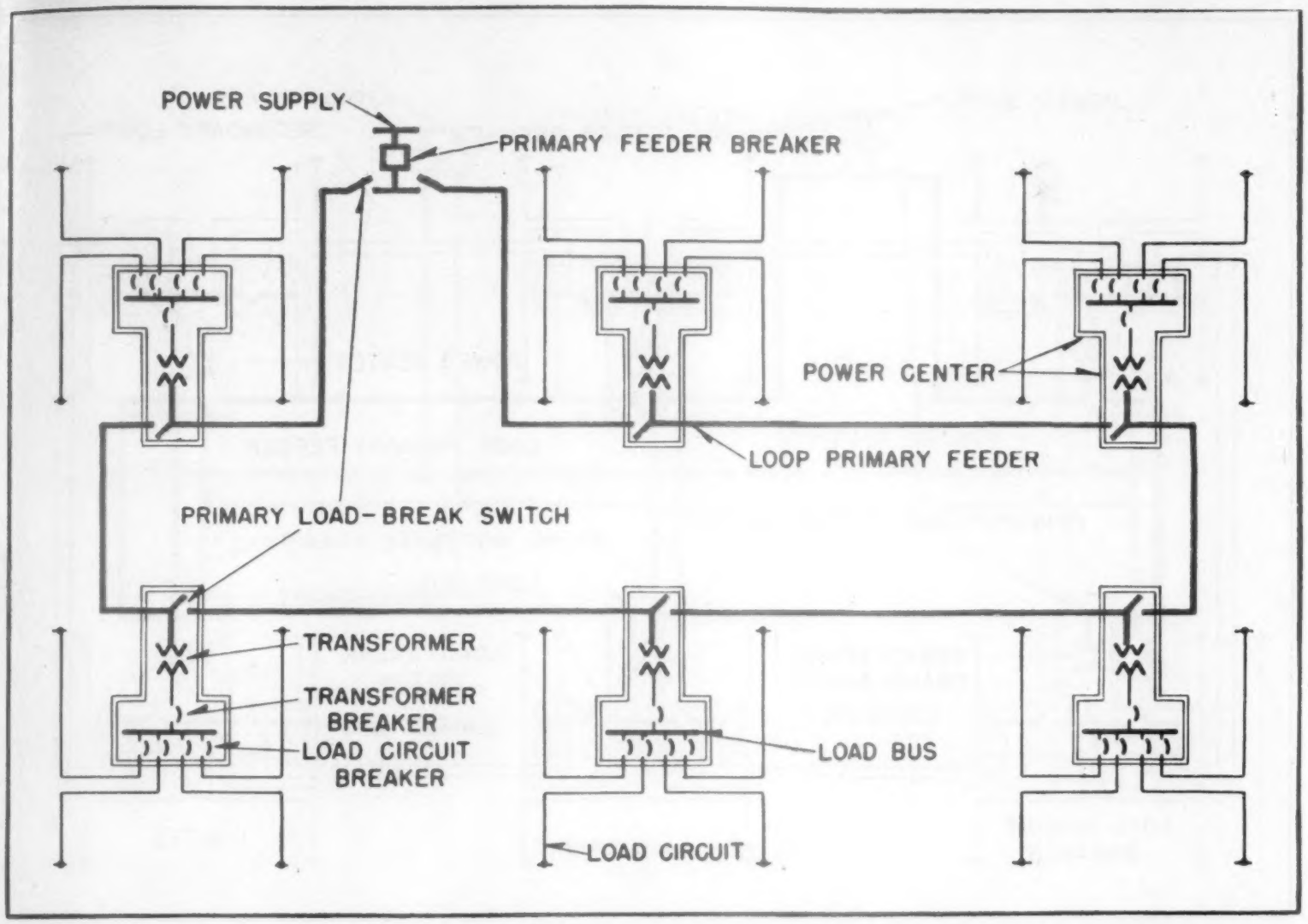


TYPICAL SECONDARY NETWORK SUBSTATION, in one of the departments of a metal-working plant, is air-cooled, and rated 750 kva., 12,000/460 volts, three phase

Flexibility and service continuity can be improved by reducing the number of transformers connected to each feeder. This increases the number of primary feeders and feeder breakers and the system investment. The extent of the outage resulting from a primary feeder or transformer fault is reduced.

If the number of primary feeders is increased, as in **Figure 1B**, so there is only one transformer per feeder, the system is comparable in service continuity to the single substation form of simple radial system. Such a system arrangement, using an individual feeder and automatic feeder breaker with each transformer, usually will be very expensive. The cost can be materially reduced, however, by replacing the automatic feeder breaker with manually operated breakers or load-break switches and backing up a number of these switches with one automatic feeder breaker.

In this form of simple radial sys-



2. LOOP PRIMARY RADIAL. PROVIDES QUICK RESTORATION OF SERVICE WITH LOW OUTAGE FROM FAULTS, AT MODERATE COST

tem a primary cable or transformer fault causes an outage to the entire area fed through the automatic feeder breaker. Service can quickly be restored to all loads except those normally fed through the faulty cable or transformer by opening its associated load-break switch. Service cannot be restored to the one load area associated with the faulty portion of the system until the fault is repaired.

2. LOOP PRIMARY RADIAL SYSTEM

This system is similar in principle to the modern form of simple radial system. It provides for quick restoration of service when a primary feeder or transformer fault occurs, as does the modified simple radial system of Figure 1B, and at a lower investment. A primary sectionalized loop or loops, each controlled by a single primary feeder breaker, are used as shown in **Figure 2**, rather than a straight radial primary feeder or feeders.

Manually operated load-break switches are installed in the feeder. Two are located just beyond the primary feeder breaker where the feeder branches to form the loop, and the others are located at the transformers. This permits any transformer and its associated section of loop to be disconnected from the rest of the system if they become faulted.

When a transformer or primary feeder fault occurs, the main feeder breaker opens and interrupts service to the load normally supplied over the faulty feeder. Increasing the number of primary loop feeders will reduce the extent of the outage from a fault, but it also increases the system investment. The faulty section of loop and its associated transformer can be disconnected from the system by the load-break switches. Service can then be restored to all but the disconnected portion of the system by closing the primary feeder breaker. Service cannot, however, be restored to the loads in the area whose transformer or primary loop section is in trouble until repairs are completed.

The cost of this system as illustrated is only very slightly more than that of the modern simple radial system of Figure 1A. The primary cable cost is a little greater, and there are two additional load-break switches in the system, one on each side of the point just beyond the primary feeder breaker where the feeder branches to form the loop. The load-break switches associated with the transformers will cost little more than the disconnecting switches in the primary leads of the transformers of the simple radial system.

The loop primary radial system may take a number of forms other than the simple form of Figure 2, just described. These forms are not described because, where the primary feeders are cable circuits as is usually the case, the same system characteristics can be obtained more economically by using one of the types of systems discussed.

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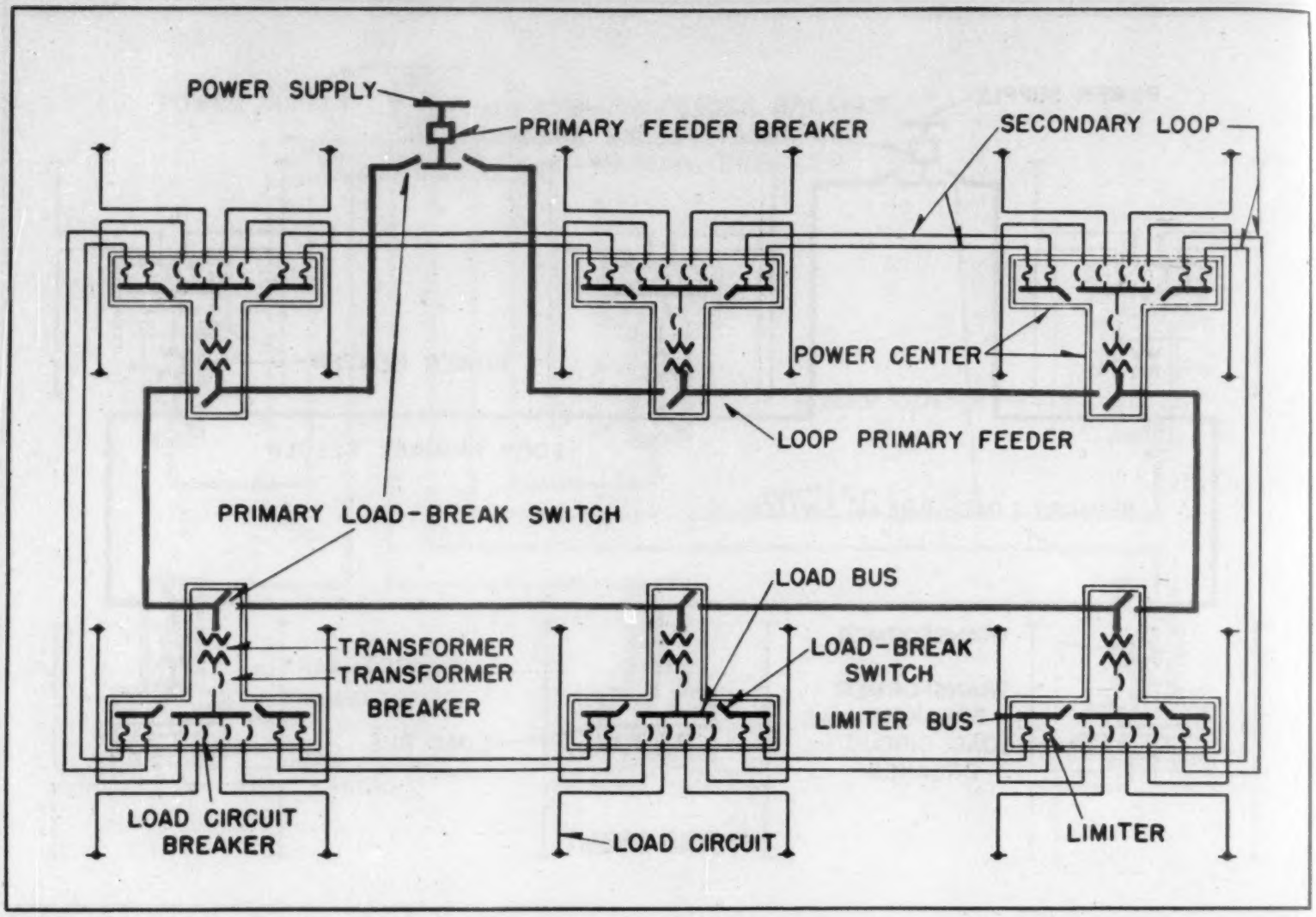


3. BANKED SECONDARY RADIAL. TOPS FOR COMBINED LIGHT-POWER CIRCUITS, ACROSS-THE-LINE STARTING OF LARGE MOTORS

3. BANKED SECONDARY RADIAL SYSTEM

This system permits quick restoration of service to all loads following a primary feeder or transformer fault. It uses a secondary loop, **Figure 3**, to provide an emergency supply when a transformer or primary cable section fails. The primary circuit arrangement is the same as that in the loop primary radial system of Figure 2.

The primary feeder arrangement of the simple radial system of Figure 1B can be used to give the same results, but it usually will be more costly.

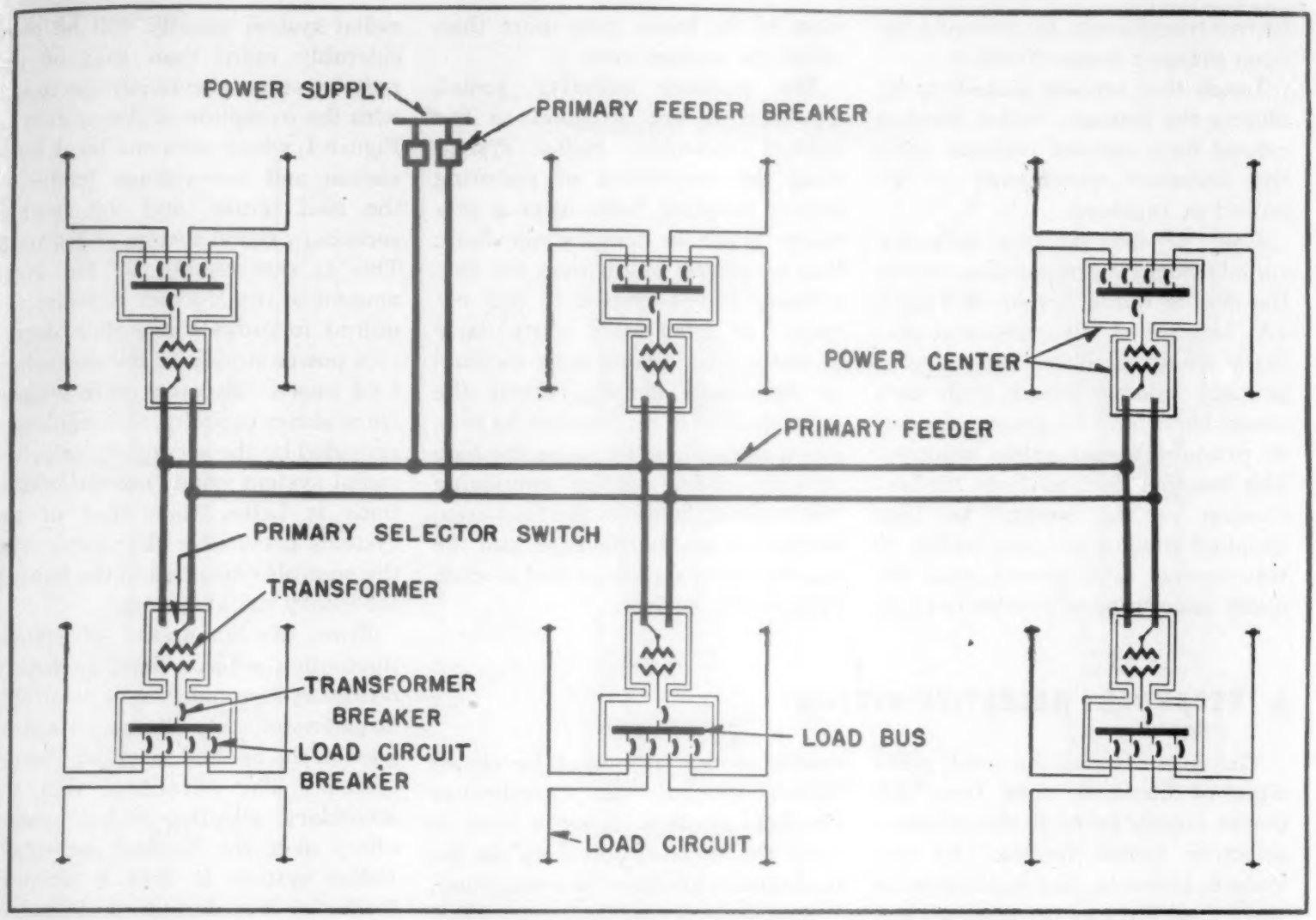
A primary feeder or transformer fault causes a complete shutdown of all loads normally supplied over the feeder. Service can be restored by opening two load-break switches and one transformer breaker and closing the primary feeder breaker. The two switches are located in the primary loop immediately adjacent to the fault and on either side of it. The transformer breaker is in the secondary leads of the transformer directly associated with the faulty section of the system. When the primary feeder breaker is reclosed service is restored to all loads. Those loads connected to the load bus associated with the disconnected transformer are fed over the secondary loop from adjacent load buses.

The secondary loop gives a number of important advantages, besides providing an emergency supply to restore service. It helps equalize the loads on all transformers, thus making it unnecessary to fit the transformer capacity at each load center to the load connected to each load bus.

Balancing transformer capacity and load at each load center is a real problem on all other types of radial systems except the radial system of Figure 1. The secondary loop permits one size of transformer to be used throughout the system, and load circuits can be run directly from the nearest bus to the loads. This reduces the length and cost of the secondary copper.

Advantage is taken of the diversity among load areas because all transformers associated with a primary feeder are connected in parallel. As a result there usually is a saving in transformer capacity over that required in any other form of radial system except the simple system of Figure 1. Also, this system is better adapted for across-the-line starting of relatively large motors than is any other type of radial system, because the starting current is supplied through several transformers in parallel rather than through a single transformer. Thus, if the starting of large motors is involved, the use of this system may result in a saving in the cost of motor starting equipment. It is likewise the most satisfactory type of radial system for combined light and power secondary circuits.

In the banked secondary radial system fault current flows not only through the transformer associated with a faulty load bus or circuit, but also through other transformers and over the secondary loop to the fault. The increased short-circuit current



4. PRIMARY SELECTIVE RADIAL. COST EXCEEDS 1A, BUT LESS LOAD IS DROPPED BY PRIMARY FEEDER OR TRANSFORMER FAULT

may require using load circuit breakers having a higher current interrupting rating than needed in other types of modern radial systems. This possible increase in cost may or may not be offset by savings in transformer capacity and secondary copper that were previously mentioned.

Comparison Is Difficult

It is difficult to make a general cost comparison between this system and the loop primary radial system. In some plants the additional cost of the secondary loop will be offset by the saving in transformer capacity and secondary copper. In other plants, because of lack of diversity and a relatively uniform distribution of load, these savings are very small and the system will cost more than the loop primary radial system by about the cost of the secondary loop. However, the advantages of quick restoration of service to all loads, greater flexibility, higher efficiency, and better voltage conditions, may justify the extra cost.

4. PRIMARY SELECTIVE RADIAL SYSTEM

The primary selective radial system, as shown in **Figure 4**, differs from those previously described in that it uses at least two primary feeders in each load area. It is designed so that when one primary feeder is out of service the remaining feeder or feeders have sufficient capacity to carry the total load in the area. While three or more primary feeders may be used to supply a load area, usually two feeders are used per load area. Half the transformers normally are connected to each of the two feeders. When a fault occurs on one primary feeder only half the load in the area is dropped.

In the preceding systems a primary feeder fault caused all load in the area to be dropped.

Double-throw or primary selector switches are used with all transformers so that when a primary feeder fault occurs the transformers normally supplied from the faulty feeder can be switched to the good feeder, thus restoring service.

In this system, as in all modern plant distribution systems, power is distributed to relatively small secondary substations located at or near the load centers. From the substation transformers power is fed through the substation switchgear units and over load circuits, either directly to the loads or through power and lighting panelboards to the loads, as in the systems previously described.

The short-circuit duty on the load circuit breakers is less than in the banked secondary radial system, and is about the same as for all other types of radial systems using transformers at the load centers.

If a fault occurs in one transformer its associated primary feeder breaker opens and interrupts service to half the load in the area, just as when a primary feeder fails. The faulty transformer is disconnected by moving its primary selector switch to the open position. Service is then restored to all loads, except those normally supplied by the de-

CONTINUED ON NEXT PAGE

fective transformer, by reclosing the open primary feeder breaker.

Loads that are not picked up by closing the primary feeder breaker cannot have service restored until the defective transformer is repaired or replaced.

Cost of the primary selective radial system is greater than that of the simple radial system of Figure 1A, because of the additional primary feeder breaker, the use of a primary selector switch with each transformer, and the greater amount of primary feeder cable required. The benefits derived from the reduction in the amount of load dropped when a primary feeder or transformer fault occurs, plus the quick restoration of service to all or most of the loads, may more than offset the greater cost.

The primary selective radial, however, is not so good as the banked secondary radial system from the standpoint of restoring service to plant loads after a primary feeder or transformer fault. It is very little better than the loop primary radial system in this respect. In some cases, particularly in fairly large plants with medium or light-load density, about the same quality of service can be rendered at less cost by using the loop primary radial system employing two separate loops in the load area, instead of one. In this case, half the transformers are connected to each loop of the system.

5. SECONDARY SELECTIVE SYSTEM

This system uses the same principle of duplicate feed from the power supply point as the primary selective radial system. In this system, however, the duplication is carried all the way to each load bus on the secondary side of the transformer, instead of just to the primary terminals of the transformers. This arrangement permits quick restoration of service to all loads when a primary feeder or transformer fault occurs, as does the banked secondary radial system.

The usual form of secondary selective radial system is shown in **Figure 5.** Each load center area throughout the plant is supplied over two primary feeders and through two distribution transformers. The capacity of each transformer at a load center must be such that it can safely carry the entire load of the area. Each transformer is connected through a transformer breaker to a secondary bus section to which half the radial load circuits feeding the load center area are connected.

A bus tie breaker is provided for connecting the two secondary or load bus sections at each load center. Normally this bus tie breaker is open and the system operates as two parallel systems entirely independent of each other beyond the power supply point. The bus tie breaker is interlocked with the two transformer breakers at each load center so that it cannot be closed unless one of the transformer breakers is open. This is done to keep the short-circuit duty on the load circuit breakers to a minimum.

A primary feeder fault causes half the load in the area to be dropped, as with the primary selective radial system. Service can be restored by opening the transformer breakers associated with the faulty feeder and closing the bus tie breakers at all load centers. When this is done the entire load is fed over one primary feeder and through half of the transformers. Therefore each primary feeder must be capable of carrying the entire load area, as with the primary selective radial system, and much more transformer capacity is required.

A fault on one of the transformers at a load center causes the associated primary feeder breaker to trip and interrupt service to half the load area. Service can be restored by opening the disconnecting switch in the primary leads and the breaker in the secondary leads of the faulty transformer, closing the associated bus tie breaker, and reclosing the primary feeder breaker. This manual switching restores the system to normal operating conditions except that the faulty transformer is de-energized and its load is being supplied through the other transformer at its load center.

Cost of the secondary selective radial system usually will be considerably more than that of the radial systems previously discussed, with the exception of the system in Figure 1, which uses one large substation and low-voltage feeder to the load center, and the banked secondary radial system of Figure 3. This is due chiefly to the large amount of transformer capacity required to provide complete duplicate power supply to the secondary load buses. Because of this spare transformer capacity, the regulation provided by the secondary selective radial system under normal conditions is better than that of the systems previously discussed, with the possible exception of the banked secondary radial system.

From the standpoint of voltage fluctuation when a load is thrown on the system, such as a relatively large motor, this system is not so good as the banked secondary radial system. The advantage that the secondary selective radial system offers over the banked secondary radial system is that a primary feeder or transformer fault causes only one half the load to be dropped instead of all the load in the area. Both systems permit the quick restoration of service to all loads when a primary feeder or transformer fault occurs.

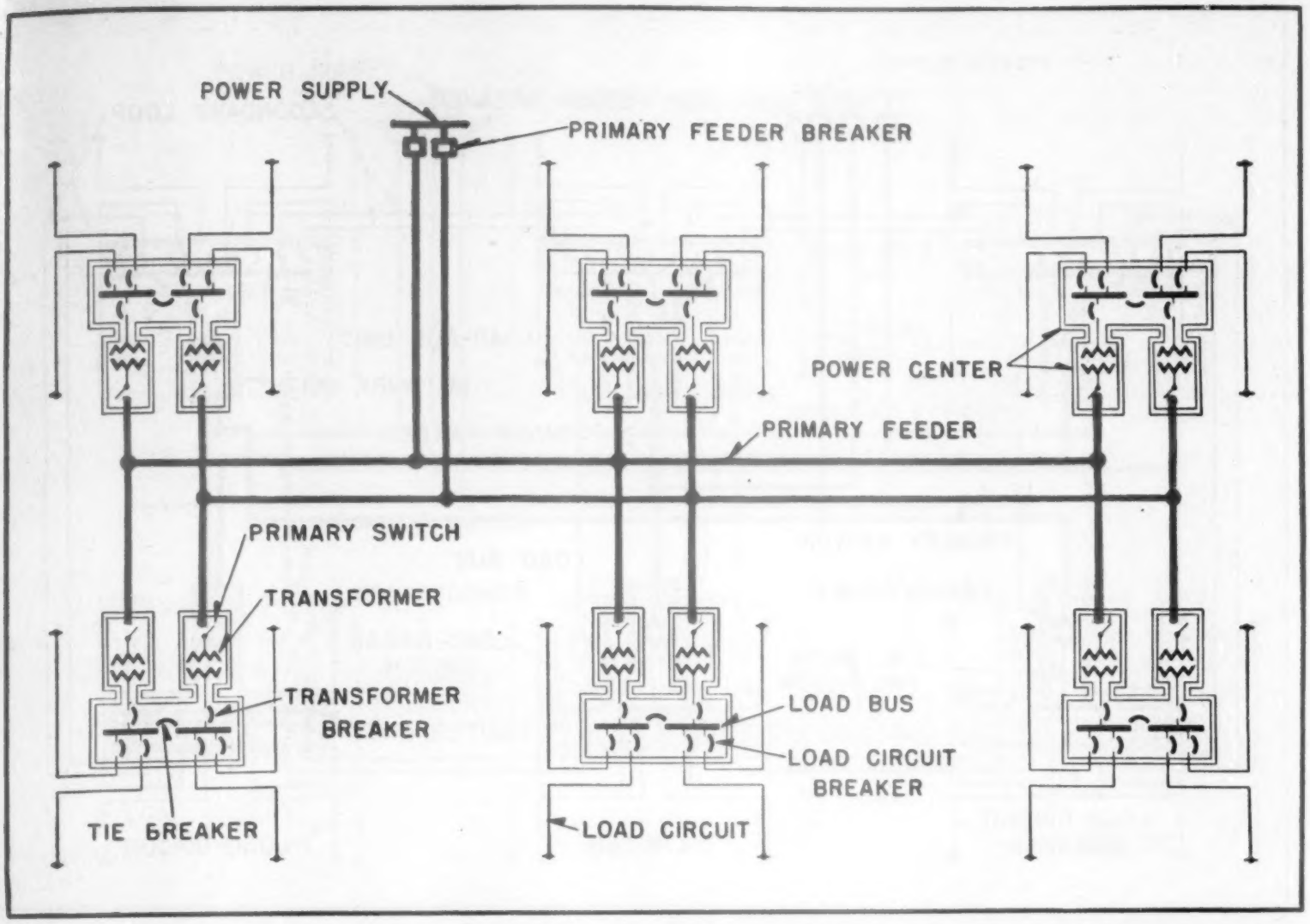
The banked secondary radial system can be more readily adapted to changing load conditions than can the secondary selective radial.

A Less Costly System

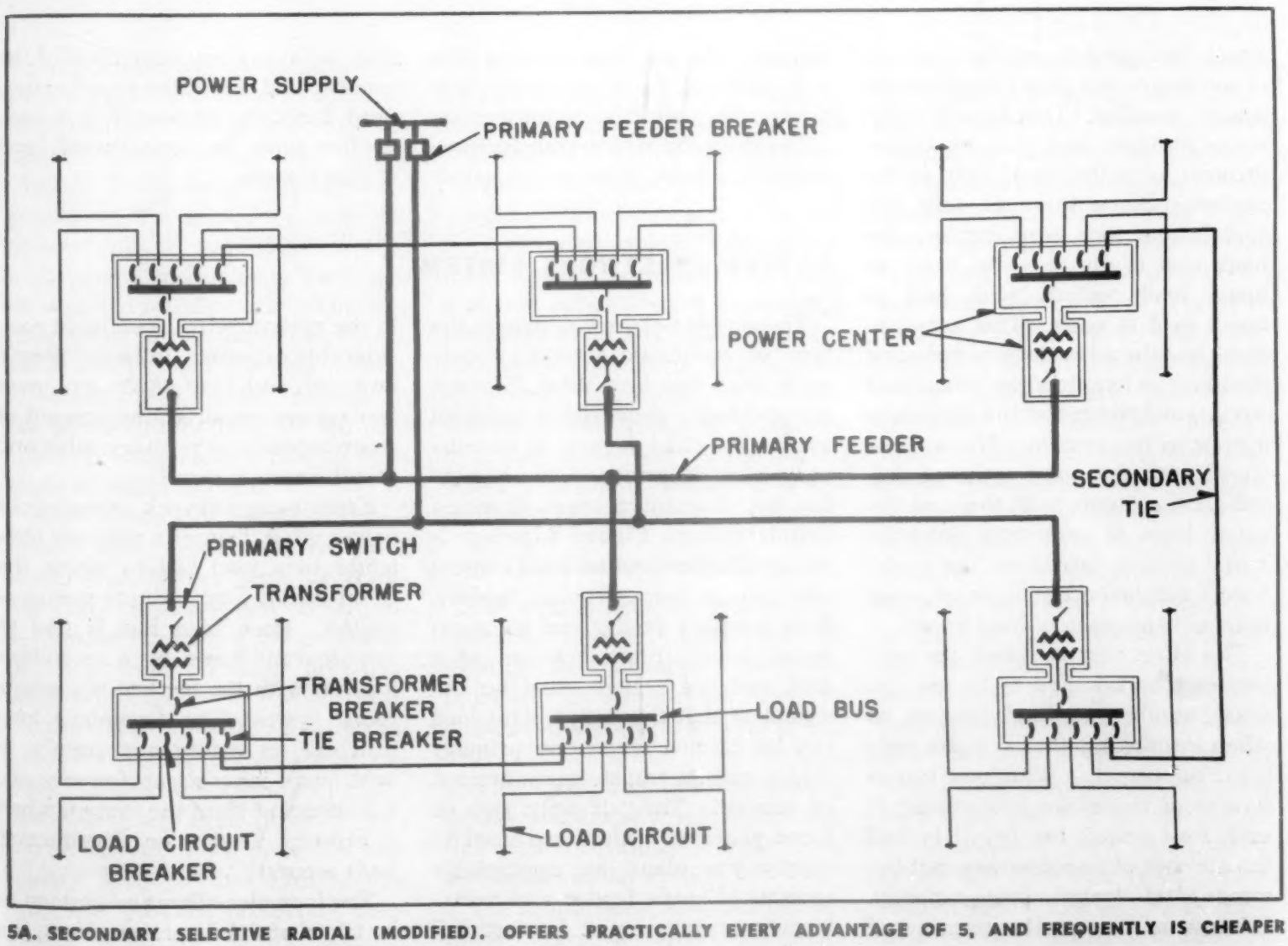
Another form of secondary selective radial system that will often be less costly than the common form previously described, is shown in **Figure 5A.** In this system there is only one transformer at each load center, instead of two. Pairs of adjacent load buses are connected by secondary cables or bus duct capable of carrying the entire load of either bus. This is done to permit picking up the load of any bus when its primary feeder or transformer fails.

Each tie circuit is connected to each of its two load buses through a tie circuit breaker. Each tie breaker is so interlocked that it cannot be closed unless one of its two transformer breakers is open.

There are two ways in which this



5. SECONDARY SELECTIVE RADIAL. GOOD REGULATION, BUT AT EXPENSE OF HAVING TO PROVIDE SPARE TRANSFORMER CAPACITY



5A. SECONDARY SELECTIVE RADIAL (MODIFIED). OFFERS PRACTICALLY EVERY ADVANTAGE OF 5, AND FREQUENTLY IS CHEAPER

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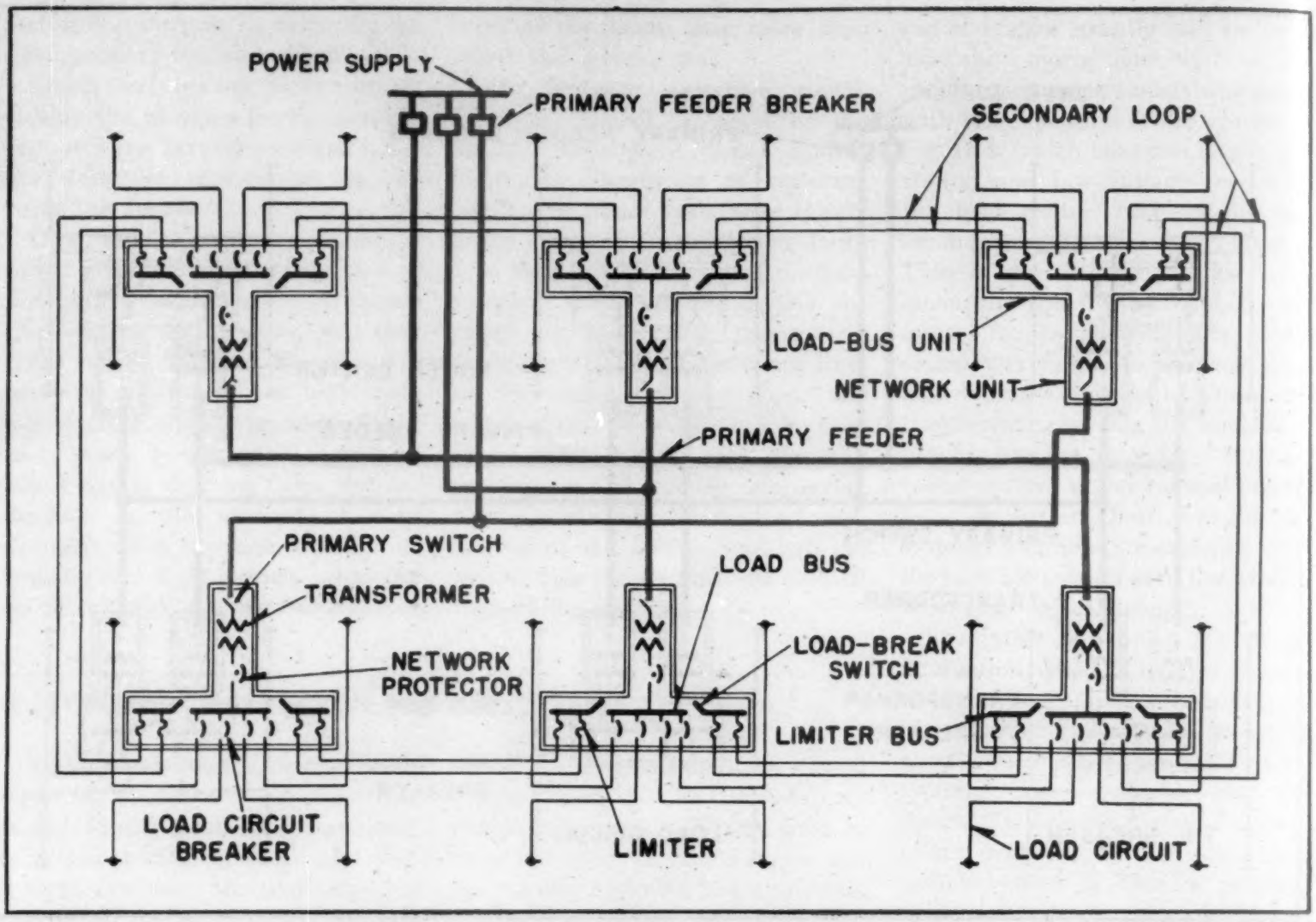


6. SIMPLE NETWORK. THE CONVENTIONAL METHOD OF DISTRIBUTING POWER IN HEAVY-DENSITY, DOWNTOWN AREAS OF CITIES

single-transformer-substation form of secondary selective radial system can be handled. One is to use the same number and size of transformers as in the usual form of the system. Since there is only one transformer per load center, the load area is divided into twice as many load centers, with half as much load at each. This arrangement has the advantage of reducing the average length of the radial load circuits and the cost of the secondary copper in the system. When compared with the other types of distribution systems both this and the usual form of secondary selective radial system introduce the problem of balancing the loads on twice the usual number of load buses.

The other way in which the system can be handled is to use the same number of load centers as when employing two transformers per load center. With one transformer of twice the kva. rating at each load center the result is half the number of transformers, but the same total transformer capacity. Because of the smaller number of transformers of larger rating this will often be the lowest-cost form of secondary selective radial system.

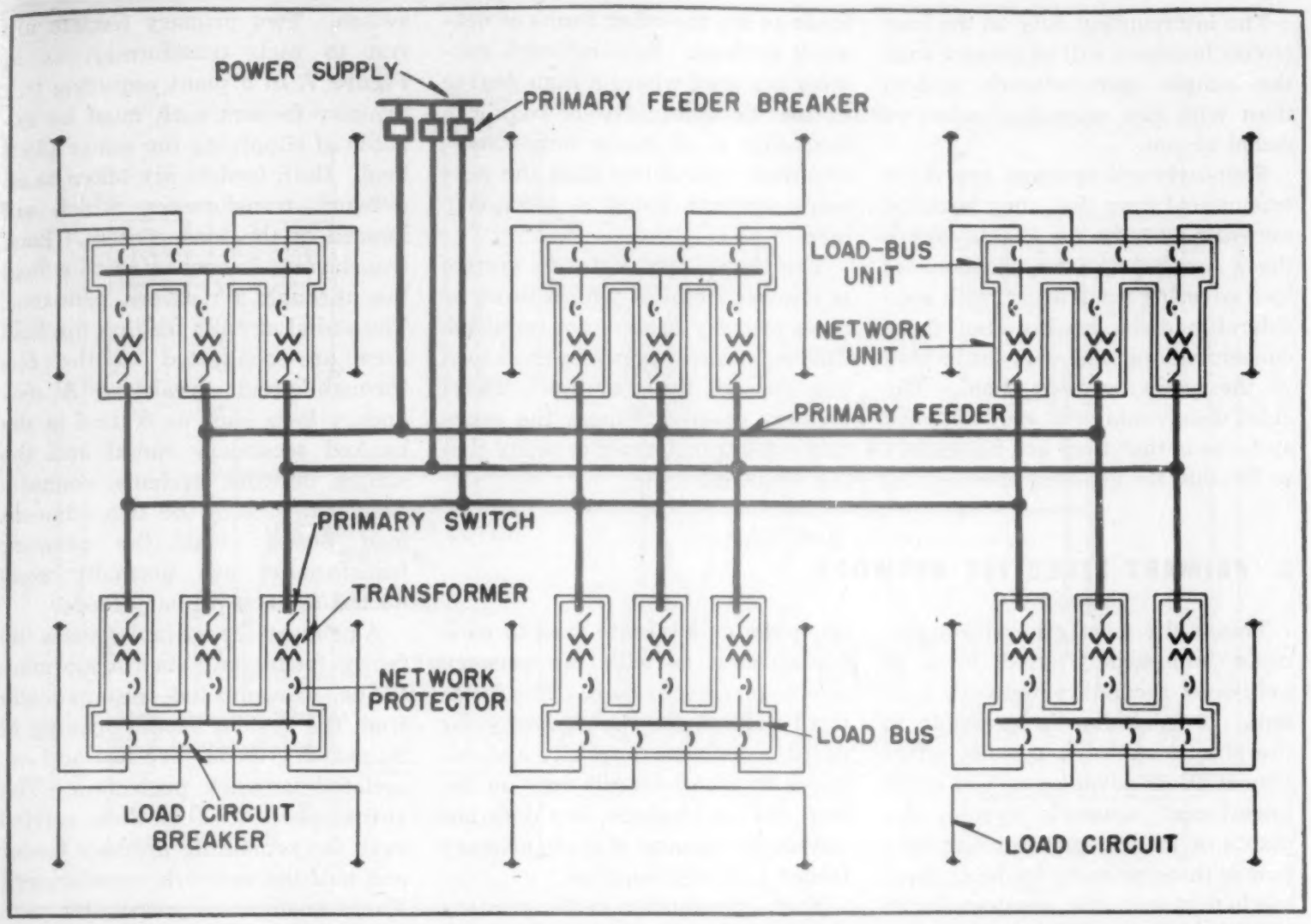
Basically the single-transformer-substation form of secondary selective radial system, regardless of the number and size of the transformers used, functions as described in connection with the more usual form of this system.

6. SIMPLE NETWORK SYSTEM

The simple network system is the type of automatic secondary network that was first used 25 years ago and today generally is accepted as the standard means of distributing electric power in the heavy-density, downtown areas of cities. In this system, **Figure 6,** power is fed to transformers at load centers over two or more primary feeders. Each primary feeder and its associated transformers function as a unit, and the system must be designed so that the entire plant load can be carried when one primary feeder and its transformers are out of service. Thus, if only two or three primary feeders are used to supply the plant, an appreciable amount of spare feeder and transformer capacity must be installed in the system, which results in considerable expense. In larger plants, however, where four or more feeders are required, the amount of spare capacity in primary cable and transformers is small.

From each network transformer power is fed through a network protector to a load bus to which the usual radial load circuits are connected. Each load bus is tied to the adjacent buses by a secondary loop, as with the banked secondary radial system. The secondary loop provides an emergency supply to load buses whose transformers are disconnected from the system when a primary feeder or transformer fault occurs.

The loop also allows advantage to be taken of the diversity among the



6A. SPOT-TYPE SIMPLE NETWORK. ECONOMICAL FOR HEAVY LOAD AREAS LONG DISTANCES APART AND LITTLE LOAD BETWEEN

various load centers, it equalizes the loads on the transformers connected to it, and may permit reducing the amount of secondary load circuit copper. Tying the transformers together on the secondary side improves voltage conditions so that both power and lighting loads can be supplied satisfactorily. This improvement in voltage conditions, particularly when starting motors, is accompanied by an increase in the short-circuit duty on the load circuit breakers above that on most types of radial systems.

When a primary feeder or transformer fault occurs, the defective feeder-transformer unit is automatically disconnected from the system, by tripping of the associated primary feeder breaker and network protectors. The network protectors are special air circuit breakers controlled by network relays. Since the network relays function to trip their breakers only when current flows from the secondary loop to the transformers, only the network protectors associated with the faulty primary feeder-transformer unit open. Therefore the plant load continues to be supplied over the good feeders and their associated transformers.

The major difference between the simple network system and any form of radial system is that a primary feeder or transformer fault will not cause even a momentary interruption to any load. It is unnecessary to perform any manual switching operations to restore service to any loads, or to relieve overloads on any part of the system when a primary feeder is automatically disconnected.

Maximum Flexibility

The simple network system provides the maximum flexibility for meeting load changes. Modifications and extensions can be made without interrupting service to any loads. Except for the greater service continuity and the slightly greater flexibility which it provides, this system is similar to the banked secondary radial system.

The simple network system sometimes takes a form commonly known as a spot-network system, which has been widely used in commercial buildings. With this system emergency capacity to prevent a service interruption when a primary feeder or transformer fails is provided by making a spare primary cable and transformer available at each load center instead of tying the load centers together by a secondary loop, as in the usual simple network.

The spot-network system resembles the secondary selective radial system in that each load center is supplied over two or more primary feeders through two or more transformers. In this system, however, the transformers feed through network protectors to a single load bus, as shown in **Figure 6A.** Since the transformers at each load center operate in parallel, a primary feeder or transformer fault does not cause any service interruption. The transformers supplying each load bus will normally carry equal loads, whereas equal loading of the two transformers supplying a load center in the secondary selective radial system is difficult to get.

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The interrupting duty on the load circuit breakers will be greater with the simple spot-network system than with the secondary selective radial system.

Spot-network systems are more economical than the other forms of network systems for plants where there are heavy concentrations of load covering small areas, with considerable distances between these concentrations and very little load in the areas between them. The chief disadvantage of spot-network systems is that they are not nearly so flexible for growing and shifting loads as are the other forms of network systems. Spot-network systems are used where a high degree of service continuity is required, flexibility is of minor importance, and their cost is less than the network systems using a secondary loop.

The simple spot-network system is most economical where three or more primary feeders are required. This is because supplying each load bus through three or more transformers greatly reduces the spare cable and transformer capacity that are required.

7. PRIMARY SELECTIVE NETWORK

This is the most generally applicable and widely used form of industrial secondary network system. It is similar in principle to the simple network system, offers almost all its advantages, and is the lowest-cost network system for plants or load areas requiring only two or three primary feeders. Saving in first cost when compared with the simple network system is accomplished by using the principle of duplicate or alternate feed to each transformer, as with the primary selective radial system. This practically eliminates the necessity for spare transformer capacity and reduces the short-circuit duty on the load circuit breakers, but does not reduce the amount of spare primary feeder capacity required.

Each transformer in the primary selective network system is equipped with a primary selector switch. Two primary feeders are run to each transformer, as in **Figure 7.** In a plant requiring two primary feeders each must be capable of supplying the entire plant load. Both feeders are taken to all network transformers, which are located at the load centers. Each transformer is connected to a load bus through a network protector. The radial circuits feeding the load area are connected to the bus through circuit breakers. A secondary loop, such as is used in the banked secondary radial and the simple network systems, connects each load bus to the two adjacent load buses. Half the network transformers are normally connected to each primary feeder.

A primary feeder fault causes the faulty feeder and its transformers to be disconnected automatically from the system by the opening of its primary feeder breaker and associated network protectors. The entire plant load is then carried over the remaining primary feeder and half the network transformers. The transformers associated with the faulty feeder can be connected to the good feeder by manually

Comparison of Plant Distribution Systems and Their

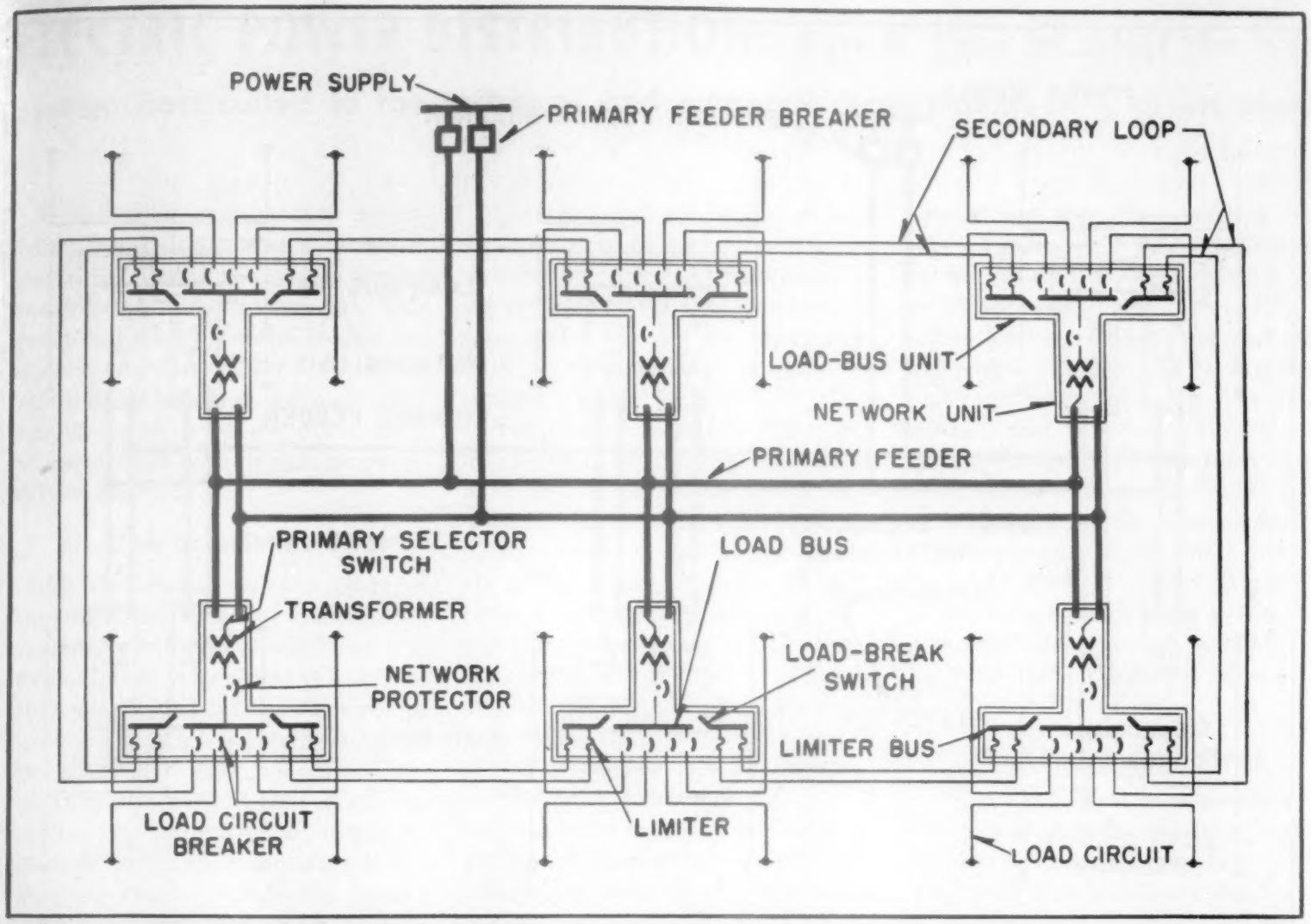
TABLE I

RELATIVE MERIT OF SYSTEMS

(where characteristics indicated are of primary importance)

		"NORMAL" PLANT	FLEXIBILITY	SERVICE CONTINUITY	REGULATION	EFFICIENCY	OPERATION & MAINT. COST	INITIAL INVESTMENT
1	SIMPLE RADIAL, CONVENTIONAL	D	D	D	E	D	C	D
1A	SIMPLE RADIAL, MODERN	C	D	D	C	C	C	B
1B	SIMPLE RADIAL, MODERN, MODIFIED	C	D	D	D	C	C	C
2	LOOP PRIMARY RADIAL	C+	C	C	C	B	B	B
3	BANKED SECONDARY RADIAL	C	B	C	C+	C+	C+	C
4	PRIMARY SELECTIVE RADIAL	C	C	C	C	C	B	C+
5	SECONDARY SELECTIVE RADIAL	D	D	C	C	D	D	D
5A	SECONDARY SELECTIVE RADIAL, MODIFIED	D	D	C	C	D	D	D
6	SIMPLE NETWORK	C	C+	B	B	C	C	D
6A	SIMPLE SPOT-NETWORK	D	D	C	C	D	D	D
7	PRIMARY SELECTIVE NETWORK	C+	B	B	B	B	C+	C
7A	PRIMARY SELECTIVE SPOT-NETWORK	C	C	C+	C	C	C	C

C+ = 79 or 80



7. PRIMARY SELECTIVE NETWORK. COMMON TYPE; LOWEST-COST IN PLANTS NEEDING ONLY TWO OR THREE PRIMARY FEEDERS

Characteristics

TABLE II

RELATIVE MERIT OF CHARACTERISTICS

(where characteristics are rated as isolated elements)

FLEXIBILITY	SERVICE CONTINUITY	REGULATION	EFFICIENCY	OPERATION & MAINT. COST	INITIAL INVESTMENT
C	E	F	E	A	D
F	F	D	C	A	A
D	E	D	C	A	C
D	E	D	B	A	A
A	C	B	A	B	D
D	D	D	B	A	B
D	B	B	D	D	D
D	B	B	D	D	D
A	A	A	C	B	E
C	A	A	D	D	E
A	A	B	A	C	D
C	A	B	A	D	D

operating their selector switches. This relieves the overload on the transformers normally associated with the good feeder.

A transformer fault causes its primary feeder-transformer unit to be disconnected from the system, as described for a primary feeder fault. The defective transformer can be disconnected from its primary feed by opening its selector switch. The feeder and its good transformers can then be immediately returned to service. A primary feeder or transformer fault will not cause any interruption to the plant load.

Cost of the primary selective network system compares very favorably with that of the secondary selective radial system. In plants where the load is quite uniform and there is little diversity among load centers, the secondary selective radial system usually will be lower in initial investment than the network system. In plants where the load is non-uniform and there is appreciable diversity among load centers, however, the primary selective network system often will be cheaper than the secondary selective radial system.

It is common practice to supply the radial load circuits only from the load buses to which the network transformers are connected. At times a reduction in system cost can be made by feeding loads from the loop at points other than those at which power is fed into it. When this is done the loop cables should preferably be paralleled and the loads taken off through load bus units. Each load bus unit should be similar to those used where network transformers connect to the loop, and consist of a load bus, two limiter buses with load-break switches and limiters, and load circuit breakers. Taking loads from the secondary loop in this way reduces the average length of the secondary circuits and the amount of secondary copper in the system.

By tapping all loads from the secondary loop at the nearest point the amount of secondary load circuit copper can be reduced to a minimum. This cannot be done practically when using a cable sec-

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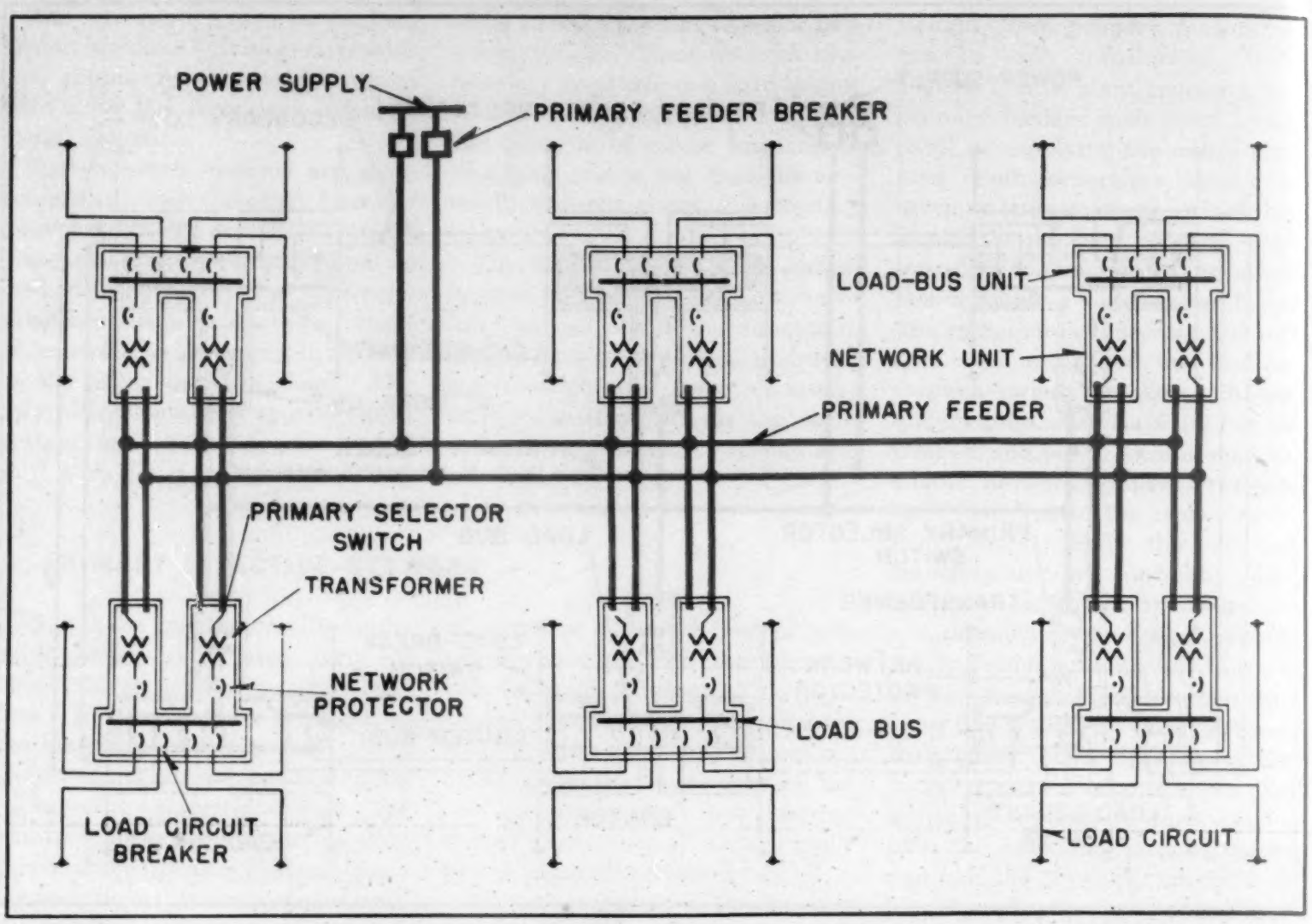


7A. SPOT-TYPE PRIMARY SELECTIVE NETWORK. LESS FLEXIBILITY THAN 7, BUT NO SPARE TRANSFORMER CAPACITY NEEDED

ondary loop and paralleling and installing limiters in the loop conductors at each load take-off point. Such a form of network system is practical, however, if two or more parallel runs of plug-in bus duct are used for the secondary loop.

In this system the transformers connect to bus units at each load center through network protectors, as in Figure 7, except that there usually will be no load circuit breakers in the bus units. All loads usually are fed through the load-break switches to the limiter buses and then through the limiters into the bus ducts that tie the adjacent bus units together.

This form of network system requires more copper in the secondary loop than those using the cable loop previously described. It also sacrifices something in service continuity when compared with network systems where the loads are fed from load bus units connected in a cable loop. This is because when a fault occurs in a section of the bus-duct loop, the loads plugged into that section will be dropped.

As with the simple network system, the primary selective network also sometimes takes the form of a spot-network system. Each transformer in the primary selective spot-network system is equipped with a primary selector switch and arranged for connection to either of two primary feeders, as shown in **Figure 7A.** This largely eliminates the necessity for spare transformer capacity and the system is ordinarily designed without providing for such capacity.

No Service Interruption

Primary feeder and transformer faults on this system are cleared without any interruption to service, as in the simple spot-network system. When a primary feeder is de-energized because of a feeder fault, the transformers associated with the good feeder will carry 160 to 200 per cent load until the transformers normally associated with the defective feeder are switched to the good feeder by their primary selector switches. After this switching operation has been completed, all the overloads on the system are relieved.

When using such a design of spot-network system, if a transformer fails the load fed from its load bus must be reduced to prevent serious overloading of the remaining transformer connected to that bus. A transformer failure will occur so infrequently, however, that the cost of providing spare transformer capacity throughout the system cannot be justified to eliminate the remote probability of having to reduce load on one bus. If the possibility of having to reduce load is objectionable, it will be cheaper to use the simple spot-network system than to provide the necessary spare capacity in the primary selective spot-network system. That system, when designed without spare transformer capacity, will be cheaper than the simple spot-network system if two primary feeders and two transformers per load bus are used. Where three or more primary feeders are required the simple spot-network system is cheaper than the primary selective spot-network system.

ELECTRIC POWER DISTRIBUTION: *Part II.* How to select the one system best suited to the technical and economic requirements of a given plant

Distribution systems for industrial plants are too often selected on the basis of using the system having the lowest initial investment. This practice usually results in the installation of a system which is neither the best nor the most economical system for the plant when all factors are considered and properly evaluated.

Six Characteristics Vital

All the major characteristics of the different types of distribution systems should be considered and evaluated or weighed in the light of the plant's load requirements in order to select the best system for the plant. The best system for any plant is the system that gives the greatest value per dollar of investment and provides adequate electric service. This is rarely the system with the lowest initial investment.

The six major characteristics that should be considered when selecting a distribution system for the plant are flexibility, service continuity, regulation, efficiency, cost of operation and maintenance, and initial investment.

Flexibility is the system's ability to be adapted to changing load conditions with the minimum of service interruptions and minimum cost of the changes necessary.

Service continuity is measured in terms of the amount of load dropped with faults at different locations on the system, taking into account the likelihood of faults in the various locations.

Regulation and Efficiency

Under regulation, the change in voltage with load, the uniformity of this change at the various load points throughout the system, and the change in voltage resulting from suddenly applied loads are all considered.

The over-all efficiency of the system from the bulk power supply point or points to the utilization devices is taken into account for both light load and heavy load conditions of operation.

Operating and maintenance costs are influenced by such factors as the nature and amount of equipment in the system and the ability to inspect, test, and maintain the equipment with a minimum interruption to service.

A careful comparison of the characteristics of the twelve major forms of industrial plant distribution systems shown in Figures 1 to 7A, inclusive, has been made. The results are in the tables on pages 108-109. Letters in the tables indicate relative standing or grading. The letter *A* represents a grading between 91 and 100 per cent; *B*, 81 to 90; *C*, 71 to 80; *D*, 61 to 70; *E*, 51 to 60; and *F*, 41 to 50. There is another very important characteristic—safety. It has not been included in the comparison because all the systems considered are safe, when high-quality equipment, properly installed, is used.

The "Normal" Plant

Based on the general comparison of isolated characteristics given in Table II, it is possible to assign weighting factors to the six major system characteristics and determine the best system to use in any particular plant. To find the relative merit of the various distribution systems for use in the usual or "normal" plant the following weighting factors were assigned to the six system characteristics: Flexibility, 3; service continuity, 2; regulation, 1; efficiency, 1; operation and maintenance, 1; and initial investment, 6.

The result of this calculation is given in the first column of Table I. It is recognized that there may be no such thing as a "normal" industrial plant. The term is used here to mean a plant whose load characteristics and requirements are closest to those of the majority of industrial plants. Eight of the twelve forms of systems are about equally applicable in a normal plant. Actually, the loop primary radial system and the primary selective network system are somewhat better than the other systems receiving a *C* grade. This is indicated by the grade *C*+, which equals 79 or 80 per cent.

The load charactertistics and requirements of most plants will depart somewhat from the so-called normal, and the weighting factors can be changed to fit the individual plant. The weighting factors to use, will depend upon the characteristics and requirements of the loads in the plant; however, they will seldom differ widely from those given for a normal plant, except possibly to increase the importance of one of the characteristics.

The "Particular" Plant

From Table II, each characteristic was taken in turn and considered to be of primary importance. Its weighting was increased until two of the systems emerged as better than the others. Thus the relative merits of the various systems when applied to other than normal plants are given in Table I.

For example, if flexibility is of greater importance in your plant than in an average plant, you will find under "flexibility" in Table II that you should use either the banked secondary radial system or the primary selective network system. The third best system for your plant would be the simple network system. The use of Table I enables you to narrow down the number of systems you need to consider from twelve to two or at the most three. Consideration of the second, and possibly third, most important characteristic will usually enable you to eliminate all but the best system for your plant.

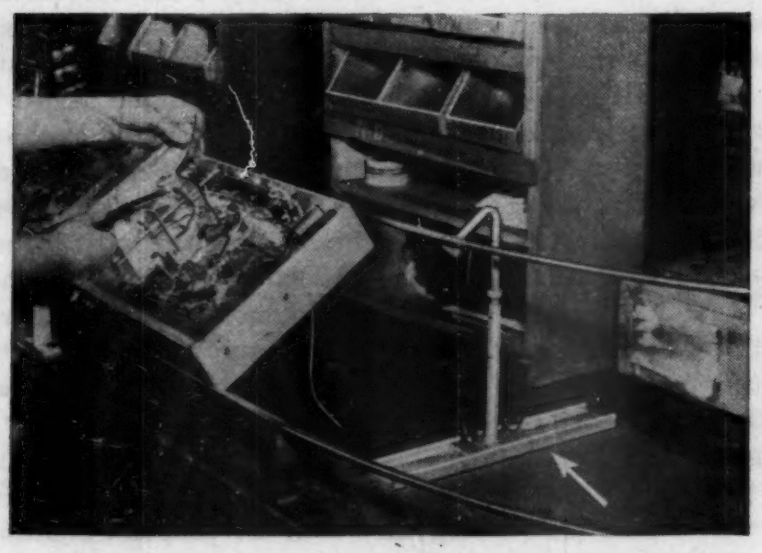
This comparison of systems on the basis of their major characteristics, together with the proper weighting of the characteristics, is helpful in selecting the best distribution for a plant without making a number of different system-design and cost comparisons. This is possible because the comparison is based on a large number of such designs and studies.

CASES IN WORK SIMPLIFICATION

Half a dozen typical methods improvements that cut costs, improve quality, make work easier. They are out of the experience of Carl M. McConkey, chief methods engineer

LAYOUTS. Soldering irons which formerly were laid on the bench are now positioned in a holder within easy reach of the worker. Solder reel is suspended directly above the workplace. The fume exhauster in front of the operator keeps the area free of smoke and fumes.

Result. Operational time reduced; work made easier and more pleasant; plant housekeeping improved.



ADJUSTABLE ASSEMBLY TRACK. The rear assembly track on the final assembly lines has been made adjustable. Wing nuts on the base of the bracket holding this track (arrow) permit the track to be moved in or out to accommodate models of every type and size. Simple as it may seem, this single improvement has eliminated entirely the former "necessity" for temporary layoffs during change-overs from one model to another. The racks located directly in front of each operator's workplace accommodate individual parts bins. Since the bins are interchangeable, it is possible to make up replacements in the stores department and distribute them throughout the plant by means of a hand truck. The empty or near-empty bin is merely exchanged for a full one. An additional feature of the parts rack is the special compartment at the bottom in which operators may place their personal articles.

Result. Need for design and construction of special assembly jig for each type of chassis eliminated; disruptions because of model change-over minimized; stock control simplified; production hold-ups resulting from lack of parts made a thing of the past.

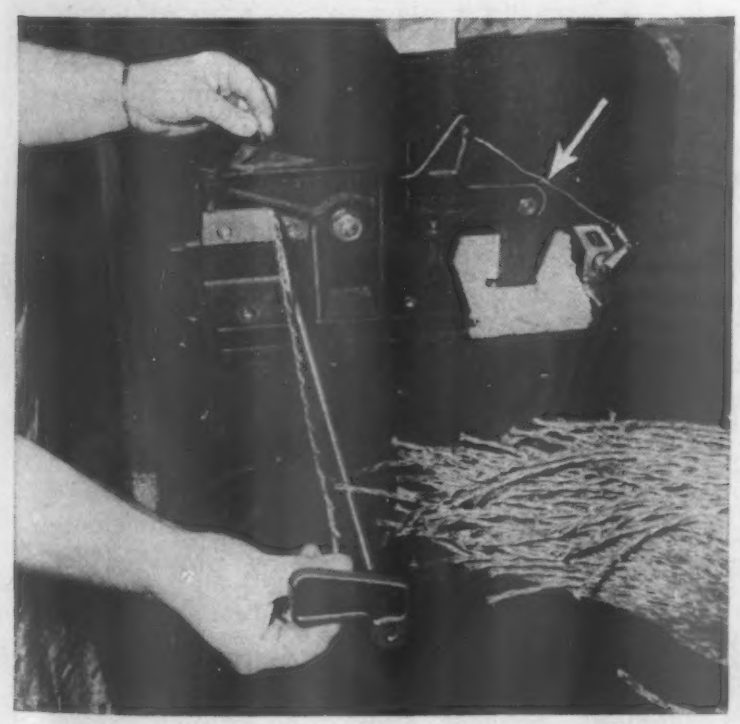
TINNING WIRE. Individual work stations are served by intakes connected to a common exhaust duct running along the back of the bench where operators are tinning the ends of stripped wire. Operations of this type were removed from the final assembly lines and placed in what Hallicrafters calls "pre-preparation" centers. Each of these centers consists of a group of light operations requiring special facilities.

Result. Improved quality of component parts; increased production on assembly lines and in the preparation center; better housekeeping.

7. The Hallicrafters Company, Chicago

PORTABLE RIVETERS. Placing riveting machines on roller casters and providing electrical outlets every four feet in the chassis department provide a maximum degree of flexibility. When a special riveting operation must be performed in the assembly lines, it is a very simple matter to move the machine to the work, rather than move all the stock to the machine.

Result. Need for changing machines over from one set-up to another eliminated; stock movement reduced; production speeded.



WIRE CUTTER. Previously, three manual operations were required for cutting short lengths of wire—feed wire from the coil, cut to length, count number of pieces cut. Now, an automatic puller feeds the wire from the coil to the cutting bench. Here, the wire is pulled through a foot-actuated cutting blade to a pre-set bench mark. An automatic counter (arrow) is attached to the cutting blade.

Result. Production up 100 per cent; operator fatigue reduced; inaccurate counts eliminated; rejects caused by improper cutting materially reduced.

MAKING THE WIRING HARNESS. The many coils of wire required to make a harness were formerly laid around in haphazard fashion; they are now mounted on interchangeable spindles, in a bracket directly in front of the operator. On the wiring board itself, common nails have been replaced by cotter pins. No longer is it necessary to wind the end of the wire around the nailheads; it is now simply threaded through the loop of the cotter pin and pulled down between the legs. This holds the wire tightly in position. A third important change in the "process" has been the placing of a job-description chart right on the wiring board. This chart provides complete information on each of the elements of the operation to be performed. Traditionally, the start and finish positions of each wire used are indicated on the board.

Result. Production up 25 to 100 per cent, depending on the model; mistakes in wiring eliminated; worker training time reduced from hours or even days to a matter of minutes.

BELTS AND SHAFTING IN MACHINE AREA REQUIRED LOW MOUNTING OF OVERHEAD LIGHTS, MUCH USE OF LOCAL ILLUMINATION

A PLANT THAT WAS DARK

Scientifically planned illumination worked a near miracle in this once-dark plant. The better light means better work

MODERN illuminating equipment and techniques have virtually turned night into day in the plant of Haskell-Dawes Machine Company, Philadelphia.

At the present time, illumination levels of 46 to 80 foot-candles meet scientifically determined requirements in every area of the plant. The contrast between this and the general level of 8 to 9 foot-candles formerly maintained is strikingly apparent in the photographs above and on the facing page.

The improvement was not brought about by simply increasing the amount of light emitted from the sources. Actually, four separate programs had to be undertaken to achieve the desired result:

1. Convert machines from belt to individual drive.

2. Replace an inadequate wiring system with one designed to meet the new requirements.

3. Repaint the entire shop and the machines.

4. Design and install a completely new lighting system.

As It Used to Be

Some years ago the lighting system was overhauled, and high-pressure mercury-vapor units were installed. These units represented the best high-efficiency source available at the time.

However, in those days all the machines in the plant were connected to a group drive, with a consequent maze of belting and line shafts. This made it necessary to locate light sources below the shafting, if objectionable shadows were to be avoided.

Even with wide-angle reflectors and supplementary local illumination at machines and benches, these conditions made it impossible to limit the variations of intensity within the desired limits. The general level of illumination of 24 to 26 foot-candles was, however, felt to be satisfactory.

Lamps and reflectors received better-than-average maintenance, but, because of the inadequate wiring and a low voltage condition which caused a severe drop in light output, readings taken during a later survey showed only 8 to 9 foot-candles were being provided for general lighting.

Preliminary Improvement

Rewiring, conversion of machines, and repainting were undertaken as prerequisites to installation of the new lighting system.

CONVERSION TO INDIVIDUAL DRIVES PERMITTED HIGH, CONTINUOUS FLUORESCENT UNITS, AND RAISED LIGHTING LEVEL SEVENFOLD

HAS SEEN THE LIGHT

Conversion. All machines were converted for individual rather than group drive. This permitted the removal of long runs of shafting and of many belts. The result was to raise the effective ceiling to the full height of the actual ceiling.

Rewiring. New panelboxes, safety switches, and control switches were put in place, and a new service entrance and panelboard installed. One conduit feed to each machine replaced the shafts and belts. All lighting was wired for 230-volt operation, and the circuits were provided with panel control.

Repainting. The shop and machines were repainted to conform to modern standards for high visibility. White was used on the ceiling and the metal trusses. The sidewalls were painted light green. Machine tools were finished in a medium gray, highlighted with buff. Windows, long a source of glare, were painted out.

As It Now Is

In the machine area, lights have been arranged in continuous rows so that there is diffused illumination on all work without interfering shadows. The rows are on 81-in. centers, with 60-in., two-lamp units mounted in continuous channel at a height of 9 feet (measured from floor to bottom of unit). This arrangement provides 60 foot-candles of illumination at the working level.

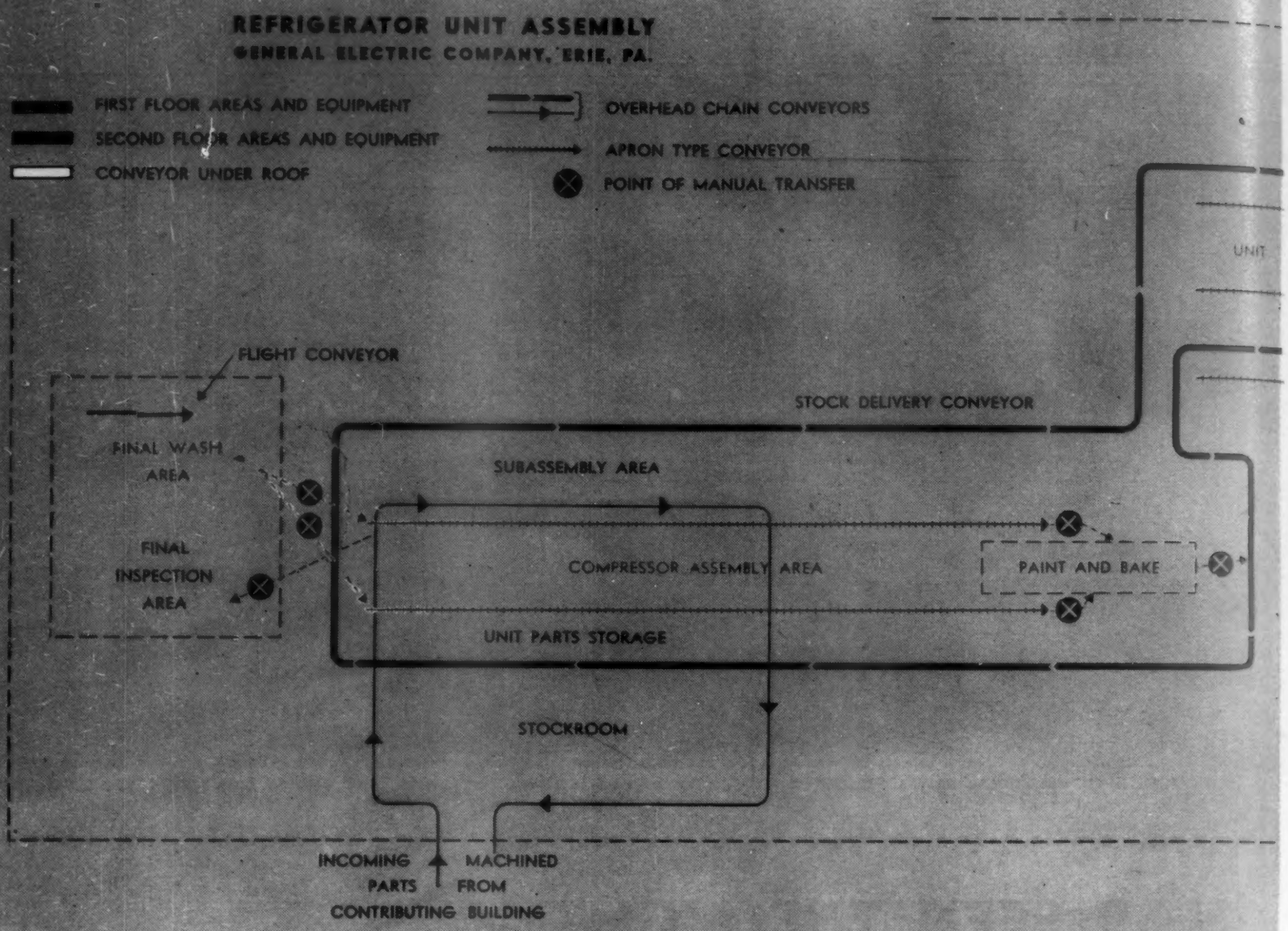
The rows of lighting fixtures are located to coincide with the machine arrangement. This results in light coming from behind and from the sides of operators—with a marked reduction in the possibility of veiling shadows and annoying glare.

The general high level of illumination in the area makes it possible to cover not only machines parallel to the walls, but also those at a 30-deg. angle with the continuous channel.

The assembly and test section is served by shorter runs of three units each, mounted at a height of 14 feet. This construction overcame the obstacle presented by a hand-operated crane, which had made installation of continuous runs impossible. The lights, above the crane and between the roof trusses, provide a general illumination of 46 foot-candles at the working level.

Bracket-Mounted Lights

Benches along one side of this room presented a special problem. Levels of 75 to 80 foot-candles were required. The solution was to hang fixtures 78 inches above the floor by means of brackets mounted on the front of the benches. Two-lamp, 40-watt units are used. The special brackets keep the fixtures out of the way, permit unobstructed operation of the crane.



MUCH OF THE 60 FEET FROM FLOOR TO ROOF WAS FORMERLY WASTED. NOW AN INTEGRATED CONVEYOR SYSTEM PERMITS

THREE-LEVEL LAYOUT BOOSTS

Two new manufacturing areas were carved out of thin air when this plant needed additional space

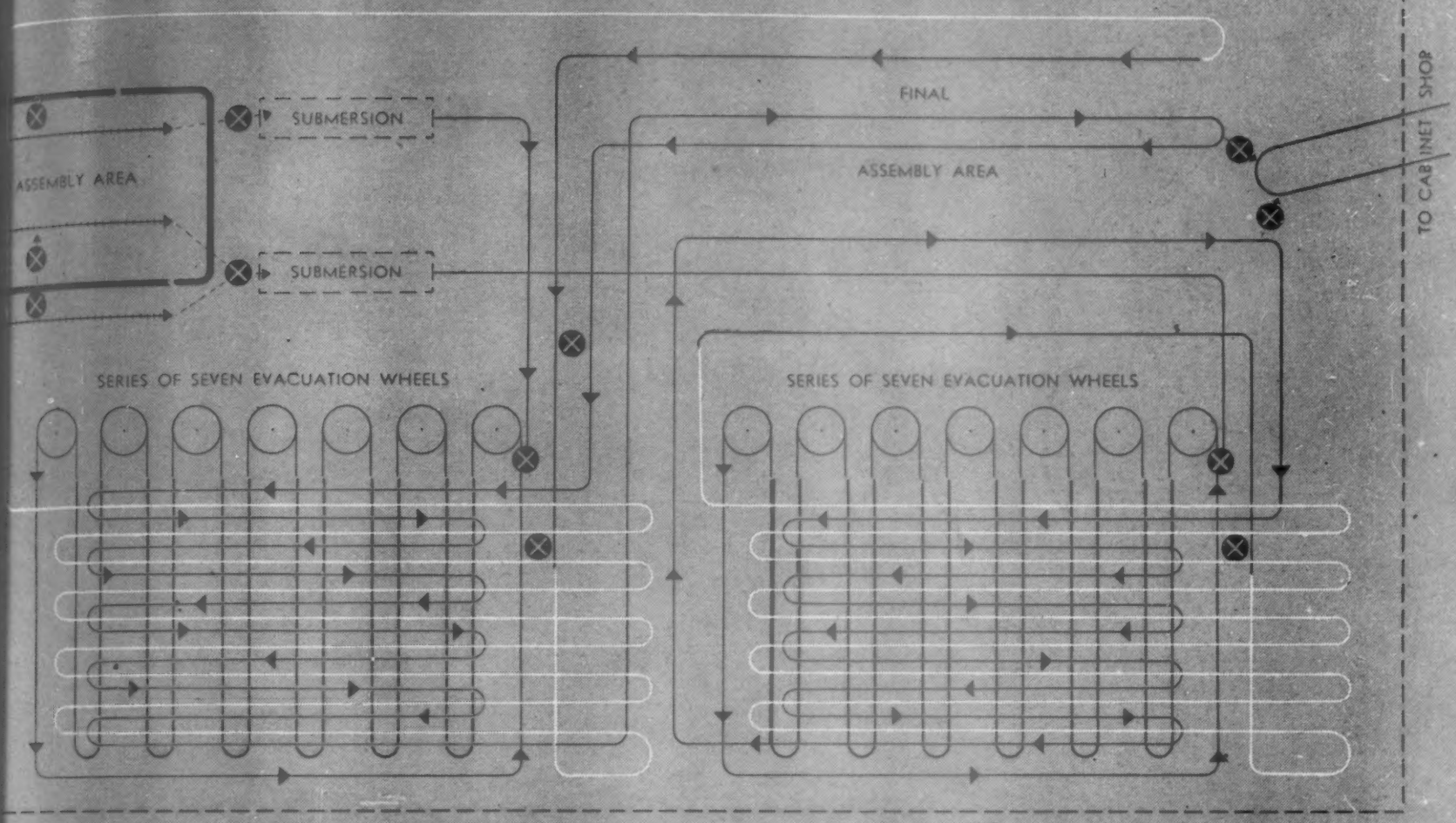
M. L. DISCO • SUPERINTENDENT, UNIT ASSEMBLY, GENERAL ELECTRIC COMPANY ERIE, PA.

OVER 65 per cent more productive capacity had to be found at General Electric's Erie, Pa., plant, to meet the post-war schedules for refrigeration units. And it was obvious that every possible inch of space would have to be utilized to achieve this objective.

First step was a scale model of the layout. The roof structure of the building was about 60 feet above the floor, so it was decided to see how many of the operations could be performed in the unused vertical space.

Careful analysis disclosed that the only operations that could not be performed in the "air" were the preliminary and the final assembly of the unit itself. With this fact definitely established, the layout was once again undertaken, and the principle of utilizing every bit of available vertical space paid off when the final layout was completed.

The pump assembly area was the first to lose its vertical space. Because of process necessity, the pump assembly area must be fully enclosed and air conditioned, to make certain that dirt does not find its way into the assembly. Also, because this enclosure is air conditioned, it was desirable to keep the ceiling as low as possible. These facts permitted the erection of a balcony in the vertical space of the pump assembly area. Here parts are stored for assembly, and pump parts are inspected.



OPERATIONS TO TAKE PLACE ON THREE LEVELS. THE RESULT IS 65 PER CENT MORE PRODUCTION IN SAME CUBIC SPACE

ASSEMBLY CAPACITY 65 PER CENT

An overhead conveyor was brought through the wall from the adjacent machine shop to carry parts up to the new storage section. Parts intended for pump assembly are routed through an inspection department located at the rear of the balcony. After passing inspection they are delivered by flight conveyor to the start of the pump assembly line in the room below.

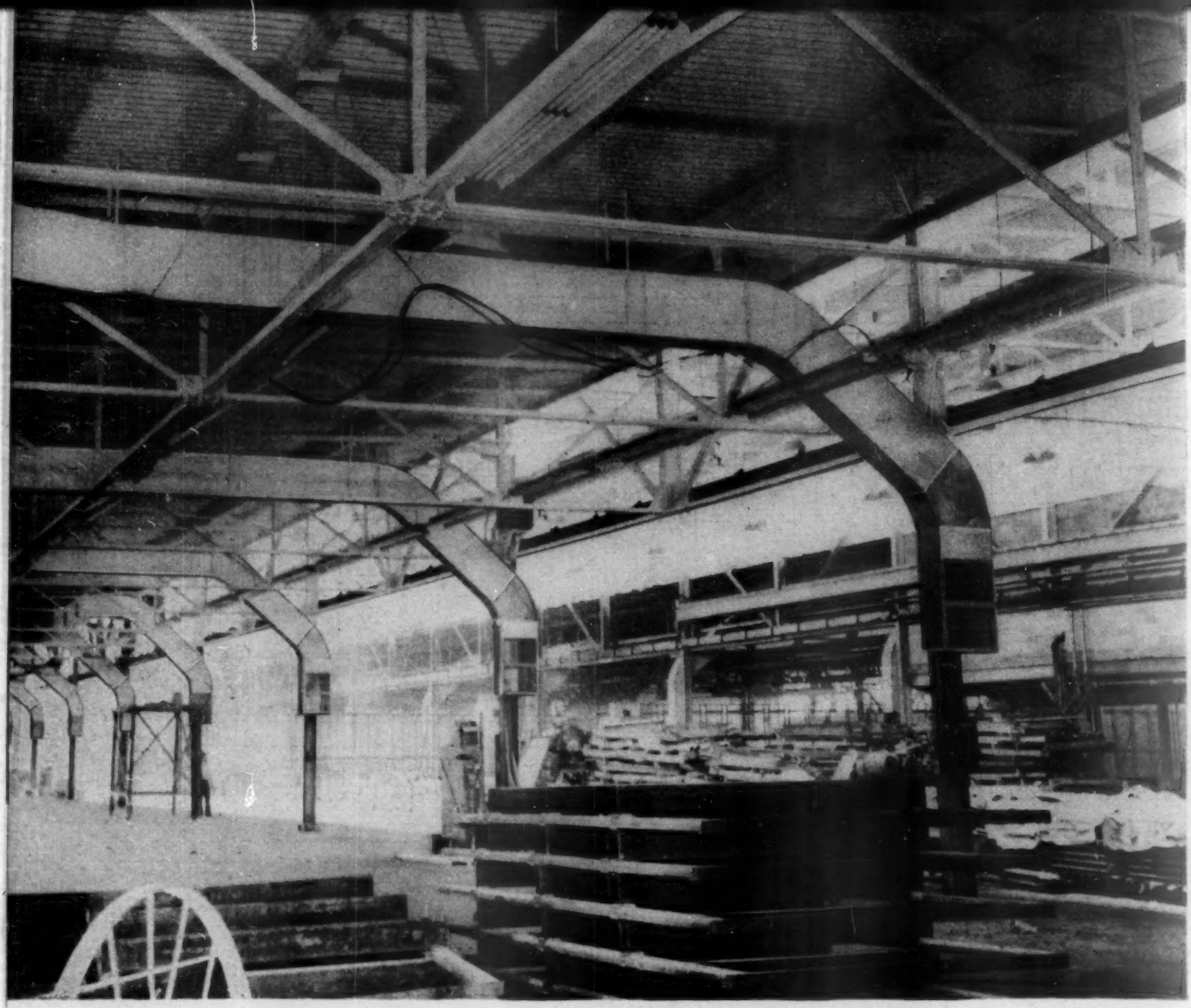
Carved Out of Space

Parts intended for the main assembly department (such as the evaporator, tubes, and condenser plate) are loaded on carriers in a predetermined sequence from this same balcony. Thus an area as large as the entire pump assembly line has been literally "carved out of space."

Nor was this the largest saving effected. After considerable study, it was found that the evacuating department drying ovens together with a large testing room made an ideal combination for using vertical space. The testing room was constructed in such a manner that the ceiling acts as a floor for the drying ovens. To obtain still further use of the available vertical space, the conveyor line from the ovens winds its way up under the roof, where it turns back and forth in the cooling cycle prior to testing. This arrangement allows a high output per square foot of building area. And much of the headroom has been used which might otherwise have been wasted.

Complete Conveyorization

All materials are handled and assembled on conveyors throughout their entire processing. Operator fatigue has been greatly reduced, and it is now possible to recruit women for more than half the jobs—in this assembly operation—a fact that has done much to keep the plant adequately staffed in the face of a manpower shortage.



FILTERED AIR IS DISCHARGED THROUGH OUTLETS THAT ARE MOUNTED ON EACH BUILDING COLUMN, 8 FEET ABOVE THE FLOOR

POSITIVE-PRESSURE VENTILATION

Ten duct systems give six changes of air per hour, keeping a slight pressure to prevent infiltration of dust and dirt

COMPACT layout, high operating efficiency ease of maintenance. These features characterize the forced-air heating and ventilating system in the new Ashtabula, Ohio, plant of The Reliance Electric & Engineering Company.

The plant is 480 feet long by 250 feet wide, and contains a production area of 120,000 square feet.

The ventilating system is designed to move as much as 18,000,000 cubic feet of air per hour through the building. It maintains a slight positive pressure, 1½ inches water gage, at all times, thereby effectively minimizing dirt infiltration. The system provides six complete changes of filtered air per hour during summer operation, and three changes per hour of tempered air in winter.

It consists of ten independently controlled duct systems that discharge air at each building column through outlets 8 feet above the floor, to assure uniform distribution.

Natural exhaust is effected through eight 66-in. diameter gravity-type roof ventilators equipped with pneumatically controlled louver dampers.

In designing this system, flexibility of control to maintain uninterrupted service was the first consideration. The second was to keep the necessary ductwork as simple as possible.

Both objectives have been realized. Interruption of the operation of one of the ten sections does not necessarily interfere with the functioning of the others. Use of several self-contained duct systems, instead of a single large one, kept the size of the ductwork down.

PLENUM CHAMBERS AND ALL DUCTS EXCEPT THE DOWNCOMERS ARE LOCATED BETWEEN THE ROOF TRUSSES AND THE ROOF

HELPS WORKER AND PRODUCT

All except the downcomer ducts were installed between the bottom chord of the roof trusses and the roof proper, where they are out of the way, but readily accessible for inspection and maintenance.

Six Discharge Points

The separate systems heat areas 80 by 125 feet through six discharge points. Downcomers closest to the wall distribute air to areas roughly 25 by 40 feet, while those on interior building columns supply areas approximately 40 by 50 feet. Outlets on opposite walls of the plant are faced in opposite directions, to maintain positive circulation of air within the general manufacturing area.

Each duct system has its own air inlet, equipped with weather-resistant louvers and located in the sash just below the roofline. Air from each is fed into a plenum chamber fitted with filters of the washable, viscous type. These filters are easily removable for cleaning and recoating. After it has been filtered the air enters a second plenum chamber, in which there is ample space for cooling coils in case summer air conditioning subsequently should be wanted in any part of the plant.

From the second plenum chamber air can be drawn into either of two fans. One fan operates the year around; the other is used only during the summer months. For winter heating the air is carried over steam coils, each of 451,000-B.t.u. capacity, converging into a single duct from which the downcomers branch out. Dampers located throughout the duct network balance the flow of air at each downcomer.

Unusual compactness of layout and high efficiency of operation are achieved through the use of new-type industrial fans. These fans are driven by single-speed motors of special type, which are mounted inside the ducts.

WORKER'S EARNINGS RECORD

NAME Mary Jones DEPT. Cell WK. END. 1/24/48

Date	Start Time	Actual Hours: Day Work	Actual Hours: On Std.	Actual Hours: Make Up	Total Allowed Hours	Allowed Hrs. Per Unit	Actual Quantity Produced	Part Number	Oper. Number	Lot Number
1/19	7:30	.5			Wait for work				353	
	8:00		2.0	.240	F 1.655	1.655	1000	824	E 99	N-922
	10:00		1.4		M 28.515	2.500	600	833	L 75	J 258
	11:24	.4			Machine down				352	
	11:48		5.7				2300			J 274
	6:00 P									
1/20	7:30		10.0				700			J 274
	6:00 P						3377			J 228
1/21					Absent					
1/22					Absent					
1/23	7:30		9.0				2929			J 233
							1500			J 349
	5:00 P									
1/24	7:30	.9			Machine down				352	
	8:24		3.6	.437	F 2.973	2.097	230	824	L 76	N 599
							988			N 698
							200			N 649
	12:00									
	Male	1.3	26.1		28.515				Approved	
	Female	.5	5.6	.677	4.628					

PAY

Sheet No. 1	Male.... JOB HOURS: Day Work	On Std.	Make Up	Allowed
	1.3	26.1		28.515
No. 2				
No. 3				
No. 4				
No. 5				
No. 6				
Total	XXXXX	XXXXX	XXXXX	28.515
	1.3	26.1		XXXXXXX

Learners Adj.	%	
Make Up		
Day Work		1.300
Total Hours		29.815
Hourly Rate		$ .77
Straight Time Pay		$22.95

4th Week -
Trans. allow. 106.4%

*Explanation of Adjustment:—

DUPLICATE PAGES IN PAY BOOK PROVIDE BOTH EMPLOYEE AND COMPANY WITH RECORD OF WORK DONE AND OF HOW PAY

PAY BOOK SHOWS HOW WAGES ARE

Workers here have complete confidence in the incentive plan because they get a copy of their pay calculation

CHARLES E. DINSMOOR • CHIEF INDUSTRIAL ENGINEER, THE ESTERBROOK PEN COMPANY, CAMDEN, N. J.

ONE of the most difficult problems in connection with any wage incentive plan is supplying the individual worker with an easily understood record and computation of his or her earnings. The workers' earnings record books in use at The Esterbrook Pen Company have been most helpful in serving this purpose.

Actually, there are two books, one with a red cover and one with a gray cover, in constant use for each employee. The two books are used in alternate weeks, so that while the red book is in the office for calculation, the gray book is in the employees' hands for the recording of his production during that week.

CALCULATION

Female... JOB HOURS

Day Work	On Std.	Make Up	Allowed	
5	5.6	.677	4.628	
				Total Male and Female Hours and Pay
xxxxx	xxxxx	xxxxx	4.628	33.143
			xxxxxxx	xxxxxxx
Trans. Adj. 6.4 %			1.330	1.330
Make Up				
Day Work			.500	1.800
Total Hours			6.458	36.273
Hourly Rate			$ .75	$
Straight Time Pay			$4.84	$27.79
Overtime 5.0	Hrs. at		.415	$2.08
Adjustments				$
Holiday Pay	Hrs. at			$
Total Pay				$29.87

WAS COMPUTED FROM THE BASIC DATA

FIGURED

Printed identification labels on the cover, with space for the worker's name, Social Security number, operator classification, and department, aid materially in personalizing the book.

Inside each book are 20 sets of printed pages of payroll forms. Each set consists of an original and a duplicate. The duplicates are so marked in red ink across the front of the page, and are perforated along the inside margin to facilitate their removal from the book. A loose sheet of carbon paper is provided with each book, so that all entries appear in duplicate. In this manner, it is possible for the payroll department to remove the duplicate pages and retain them as a permanent record, while the returned book provides the employee with full information on his earnings and how they were computed. The flyleaf of each book, headed "Instructions for Worker's Earnings Record," is devoted to telling both the operator and the shop payroll clerk how to fill in the forms.

Among other things, operators are warned to "Make sure that you are properly credited in your payroll book for the work you perform at the time such work is completed."

Payroll clerks are told "You are responsible for all books while not in the payroll department."

Work Record

The front of each page in the earnings record provides space for all pertinent production information to be entered at the time work is actually performed. Additional columns are provided for later recording of allowed hours per unit, total allowed hours, and make-up hours (computed only where actual hours exceed total allowed hours).

Appearing on the reverse side of each sheet in the book (both original and duplicate) is a standard form used for actual calculation of the employee's pay. Before making any entries on this form, the sheet of carbon paper betwen the original and duplicate is reversed, so that every entry and calculation on this form, too, will appear on the company's as well as the employee's record.

Mechanics of pay calculation are made extremely simple by the use of the printed form. Once explained to them, employees have no difficulty in subsequent weeks in following the exact method by which their pay was computed. If an employee wishes, he can check all the computations from the raw production data right through to his total pay. The only figure that the employee cannot verify at the time it is entered, or by later computation, is the allowed hours per unit. Should an employee believe that a mistake has been made in this entry, it is a simple enough procedure for his steward or supervisor to check it for him.

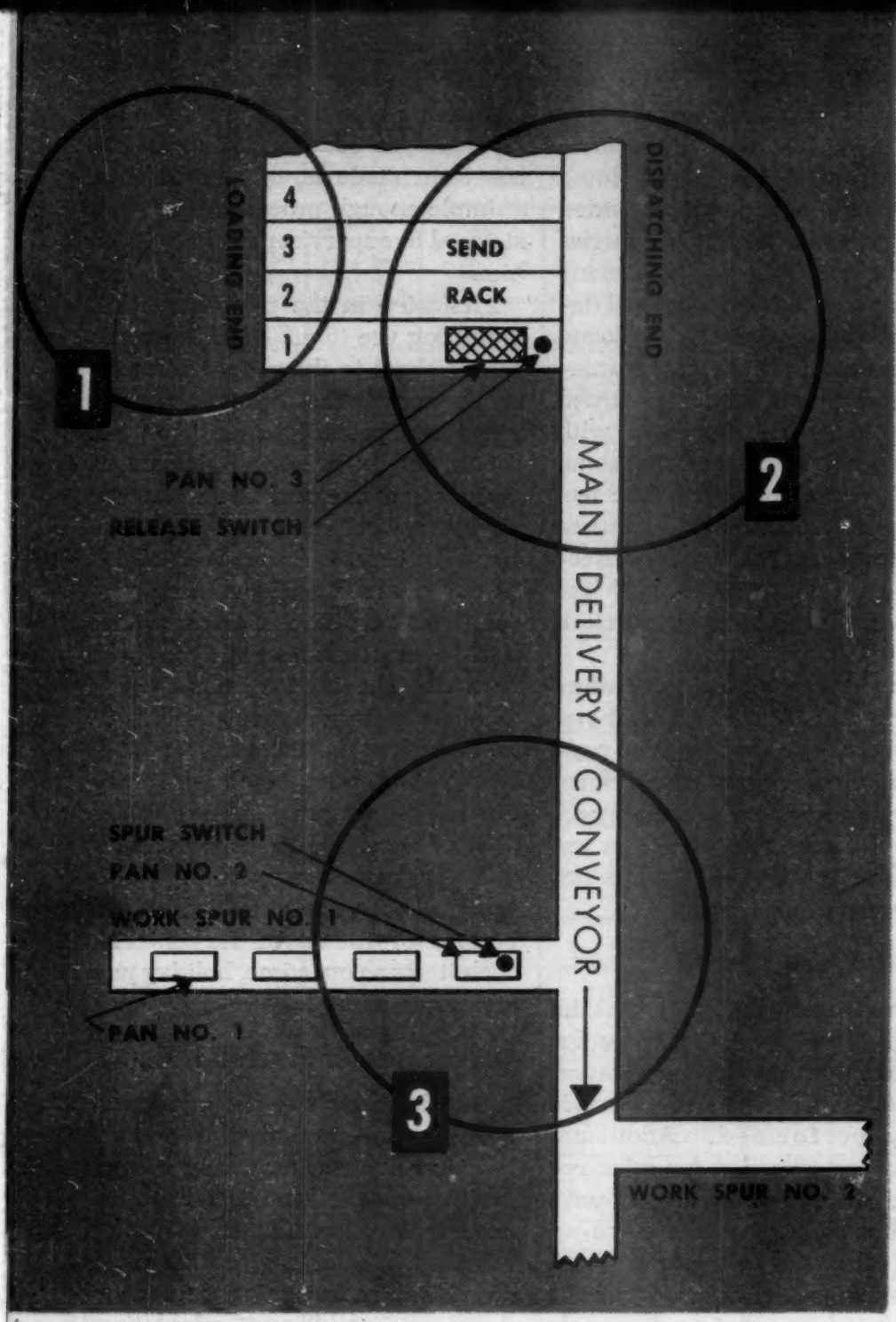
First step in the pay circulation is posting the totals from the work record sheet to the proper columns on the pay form. Spaces are provided for posting totals from six sheets, but in practice it is seldom necessary to use over two sheets for recording work in a given week. The two identical blocks headed "Male" and "Female Job Hours" are provided to take care of cases where female employees work on jobs normally classified as male work, which calls for a higher hourly rate. To complete the computation, it is simply necessary to apply the transfer allowance (if any) to the allowed time, add up the total hours, and apply the hourly rate. Additional spaces are provided at the bottom of the form for entering such items as overtime, holiday pay, and adjustments.

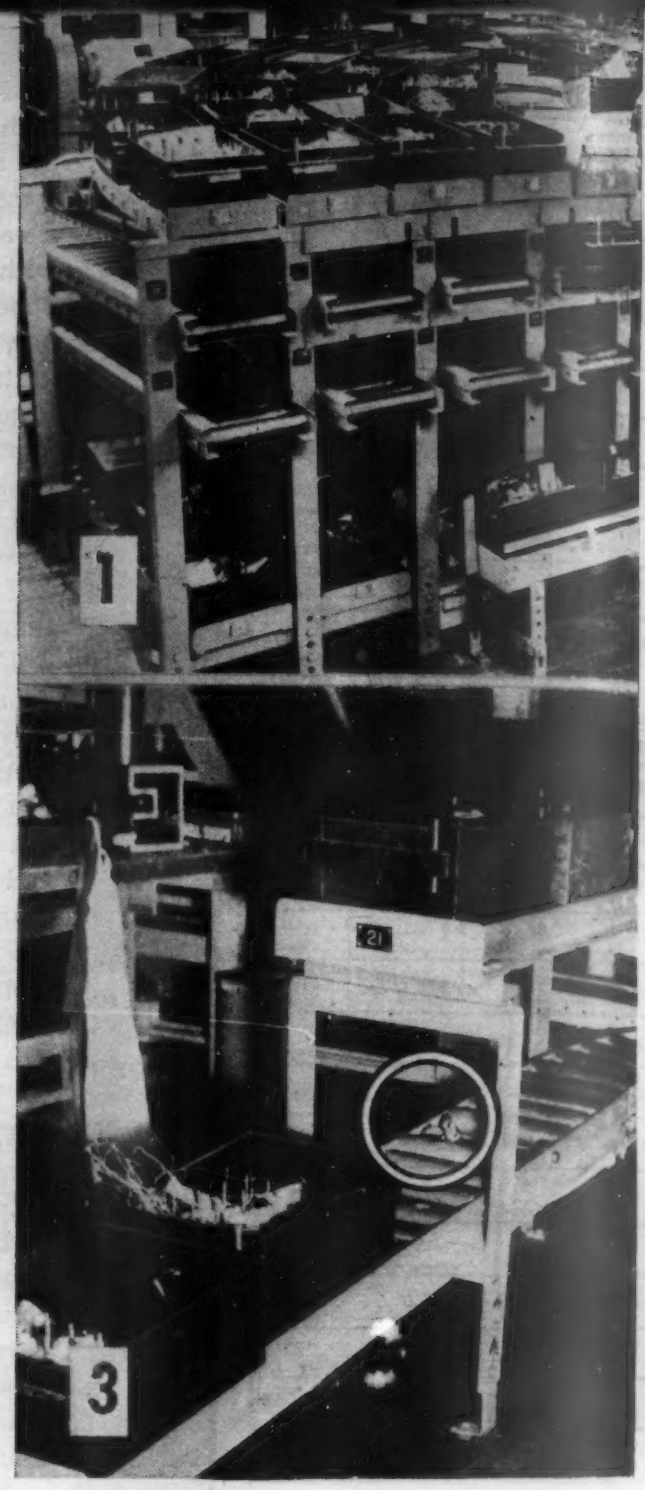
Workers Understand Plan

One further step—and a very important one—was taken to educate the incentive worker in how his pay is calculated. Esterbrook draftsmen took an actual sample of a completely calculated set of pages from a worker's earnings record and drew up an "hour calculation" (based on the front side of the page), and a "money calculation" chart (based on the reverse side of the page). Each and every entry and calculation was fully described in the margin of the chart, with arrows reaching to the appropriate entry. A framed 18x22-in. black and white print was placed on the bulletin board in each of the production departments operating on incentive.

Employees' questions regarding method of calculation are quickly answered by reference to this actual example.

Workers' earnings records of the type described have not only helped to create and maintain confidence in the incentive plan, but have also greatly simplified checking payrolls and preparing departmental and plantwide employee efficiency and labor analysis reports.





AUTOMATIC DISPATCHER shown schematically in the diagram above is controlled by the electronic release timer pictured at the lower right on opposite page. There are three basic elements in the set-up. . . . 1. The "send" rack contains one rack for each of the 27 work stations in the shop. Totepans are loaded into rack numbered to correspond with work station where next operation is to be performed. . . . 2. Release from send rack is through special mechanism which permits pan to make 90-deg. turn. The solenoid

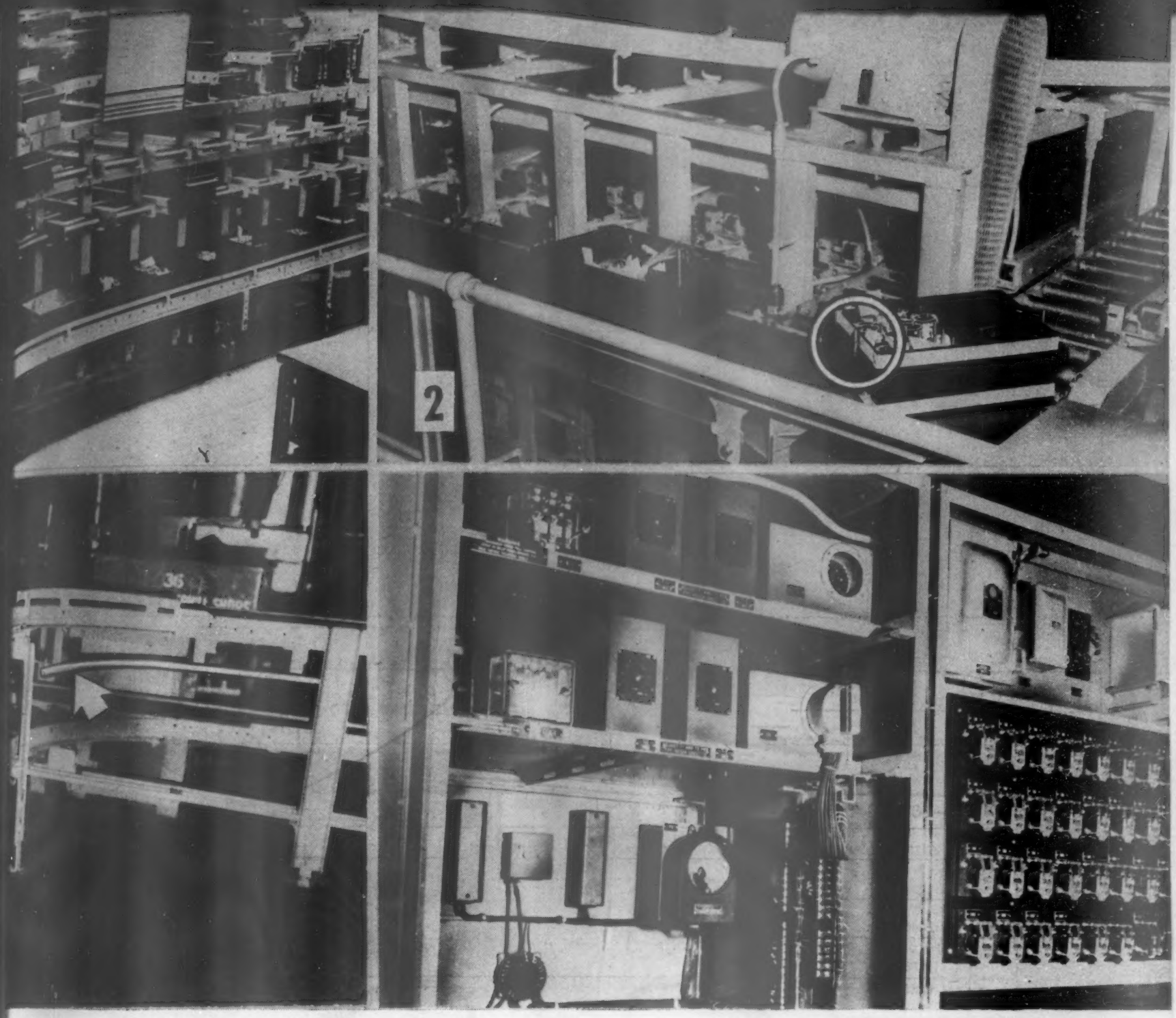
AUTOMATIC DISPATCHING MEANS

JACK R. DUNN • ENGINEER, WESTERN ELECTRIC COMPANY, INC. HAVERHILL, MASS.

THE highly specialized nature of telephone equipment requires one of the Haverhill, Mass., shops of the Western Electric Company to manufacture over 2000 different types of electrical coils. Routing of individual coils through manufacturing varies from 2 to 20 operations. The sequence of operations lacks uniformity. Weekly output is about 700 orders, and the average quantity per order is 20 coils. Overall, material must be scheduled for and delivered to about 7000 "operations" each week.

To help correct the difficulties common to typical small-lot manufacture, the production control system was re-engineered and a trial system was installed in one of Western's Haverhill shops. The manufacturing floor of the trial shop was subdivided into 27 groups through which work is controlled.

Connecting these groups to the dispatch area is a power-driven main conveyor with both delivery and return belts. Branching off the



switch (arrow) which controls release is operated through timer. Setting of pin on pan (circle) determines work spur to which pan will be delivered. . . . 3. Deflector arm on main conveyor (arrow) catches pre-set pin and sends pan to proper work station. When pan is removed from near end of lower roller, others slide forward to release solenoid switch (circle). This starts next pan on its way. When job is completed, pan is returned via upper section of continuous belt. Pin is then reset and pan reloaded for next operation

MINIMUM MANPOWER

main belt are 27 delivery and return spurs of roller construction. The main conveyor is 189 feet long with a single belt for both delivery and return.

The work group spurs are constructed of roller sections approximately 4 feet long for return and 15 feet long for delivery. Both the delivery and return work group spurs are adjustable for pitch, which is critical, as the load varies up to 500 per cent for individual workpans. This permits adjustment of the spurs to accommodate worn rollers and similar maintenance conditions.

To direct each workpan to its correct position, the conveyor pans have been designed with holes at both ends into which pins are inserted. At each work delivery spur a deflector arm is so located that for a particular pin location the conveyor pan is deflected to that spur.

Complete responsibility for maintenance of delivery schedules has been delegated to the dispatcher, and the floor supervisors are now responsible only for quality and efficiency of operators. To aid the dispatcher further, he has been given complete authority to determine which jobs shall be processed and in what order.

If the routing of jobs from one

CODE	QUANTITY					
D-167286 Trans.	18					
A. MACH.	33EN WIRE SIZE	10/4 TURNS	11 WIND	/4 SHIP	HRS/C	25.0

"HOURS"

WINDING LOAD CARD

A

CODE	SHIP QUAN.	INVENTORY	MAKE QUAN.
D-167286 Trans.	15	0	18

OF SPLIT SCHED.	COMBINED SCHED.	SHIP DATE	WIND DATE	GOV. INS.
		11/4	10/4	

	PROCESS PARTS AVAILABLE
	WINDING PARTS AVAILABLE
	ASSEM PARTS AVAILABLE
✓	ALL PARTS AVAILABLE

REMARKS

	P X	S Y
WINDING MACH.	A	A
WIRE SIZE 33EN	38	DN

JOB STATUS CONTROL CARD

B

NERVE CENTER of control and dispatch system is three-section board shown at top. Electronic timer is behind center section. Winding load cards (*A*) are trimmed so that length of right portion corresponds to hours of load. Job status control cards (*B*) show past routing and present location of each order. When all cards are placed in board, they provide quick picture of load conditions

group to another were handled by the shop supervisors there would be no centralized control, and serious control problems would be encountered. Therefore, at the completion of each operation the individual jobs are returned to the dispatcher, where they are rerouted to the next operation.

To handle the material throughout manufacture, and to control the loading of each work group, the system employs a new type of "send" rack in the dispatch area. This send rack has been connected mechanically and electrically with the main belt and work spurs to produce automatic dispatching.

Each delivery spur has a limit switch which closes to establish contact when not depressed by a conveyor pan. The dispatch area, in turn, contains an equal number of send racks, with one send rack allocated to each spur. On each send rack there is a solenoid stop, which prevents the workpans from rolling onto the main belt of the conveyor. Material required for the shop is selected in advance and

stored in the send rack corresponding with the work spur for which it is destined.

To illustrate the automatic dispatching, assume that an operator served by spur No. 1 requires work. The job-setter removes pan No. 1 (see diagram) from the spur and places it at the operator's position. Since the spurs are pitched, the remaining pans roll in the direction of the arrow and pan No. 2 will no longer rest on the limit switch (represented by a circle). This switch will then be closed and an electrical circuit will be completed to the solenoid switch on send rack No. 1. This switch will open, and, since the send racks are pitched, totepan No. 3 will roll in the direction of the arrow along the main belt of the conveyor. With the use of the pins and deflector arms the pan will be directed to spur No. 1 and the work load will be brought back to normal.

In the design of the send rack, space limitations prevented the use of arc turns, so it was necessary for the pan to make a 90-deg. turn from the send rack to the main belt. This was accomplished by employing a vertical roller, two power-driven rollers, and a third roller divided in three sections with the outside section power driven.

Pans Move One at a Time

To prevent all spurs dispatching at the same time and thus causing jams, an electronic timer is employed which also times the operation of the solenoids so that one pan is dispatched at one time from each send rack. Since a failure of this timer would make the system inoperative, a spare timer has been provided, and for changing timers all associated wires are in a single removable plug.

The problem of individual machine loading was resolved by loading the "bottleneck" operation only.

In the manufacture of coils, the winding process is normally the first operation and, in general, is the most likely to cause trouble from a machine loading standpoint. Experience has shown that in most cases if a coil is wound on schedule, it will be delivered on schedule. Therefore, individual loading of the winding operation provides maximum efficiency in scheduling and dispatching with a minimum of clerical control.

This is accomplished with winding load cards (*A*, on facing page). The section to the left of the cutout is for identifying information and the section to the right of the cutout is a graphic representation of time. By calculating the total time required to wind each order and cutting the right section of the card to the corresponding length, a graphic representation of the winding hours for each job is available. This card is then folded at the cutout, and the right section entered in a slot on the winding load control board. Since the right sections of each card make butt joints with the preceding and following cards, hours for each order are automatically added.

Colors Show Dates

The winding load cards are supplied in seven colors. Five represent the weeks of a fiscal month, one color is for back schedule, and one for rush jobs. On each order, the manufacturing interval is subtracted from the delivery date, and a date is obtained for the winding operation. The color of the winding load card is then chosen in accordance with the winding date. As a result, the winding control board visually indicates to the dispatcher the following information:

1. The winding period for each order.

2. The relation of the orders as to the exact time during any given week that winding will be started and completed.

3. The over-all winding load as to back, current, or future work.

4. The load in hours on each machine.

With the above information the dispatcher has at all times an exact picture of his winding load. This not only permits accurate dispatching of work but the reallocation of men and machines to meet the fluctuations in current schedules.

To coordinate and control the dispatching of work throughout manufacture, a job status control card (*B*) is issued simultaneously with the winding load card. This card contains identifying and material status information, as well as a record of the exact location of the job during manufacture. The job status record is posted by a dispatch clerk who enters the group number in the provided space when a workpan is dispatched. Upon return of the workpan the same space on the form is filled with a rubber stamp thus indicating that the job has returned to the dispatch area. However, the number is still visible through the ink stamp so that on any order the dispatcher knows at all times the past routing of the job.

With the job status control card (which also is furnished in seven colors) and control board, the dispatcher determines, at a glance, the over-all status of the shop as to back, current, or future schedules. And, most important, he knows at any time the exact location of each and every job. Since the sequence of processing each job relative to other jobs must be maintained, as determined by manufacturing intervals and delivery schedules, special circular storage racks have been provided to permit the removal of pans in the same order in which they were stored.

Card Travels With Work

In the routing and rerouting of each job from one operation to another it is essential that the correct work spur be selected for the next operation. To assist the selector in the rerouting of work a dispatch route card is issued for each job and accompanies the work during manufacture. A record of defects also is maintained on the route card so that manufacturing difficulties may be analyzed. This card is later filed as the manufacturing record of the completed job.

At the present time an investigation is being made of each component of the system to evaluate accurately its advantages and it is anticipated that minor experimental changes will be made. However, during the time that the system has been operating on a trial basis it has been definitely proved that a centralized production control system employing a suitably designed conveyor will increase handling efficiency, maintain production schedules, and increase the quantity of product.

"PICK-UP" OF SIMPLE BOLT FROM BIN

Computation of standard time allowance from tables

	MOVEMENT	MOTION ANALYSIS	WORK FACTORS	TIME ALLOWED (Minutes)
1	Transport hand empty to bolt in bin	A-14"	1 (D)	0.0069
2	Grasp bolt	F-1"	None	0.0016
3	Regrasp bolt (50% occurrence) (Two finger motions required 50 per cent of the time—2 x 0.0016 x 0.50 = 0.0016)	F-1" (2)	None	0.0016
4	Separate bolts (25% occurrence) (Two finger motions required 25 per cent of the time—2 x 0.0016 x 0.25 = 0.0008)	F-1" (2)	None	0.0008
5	Transport bolt to nut in other hand	A-14"	2 (D, S)	0.0090
		TOTAL ELEMENTAL STANDARD TIME		0.0199

Work Factor Symbols

W Weight or Resistance
S Directional Control (Steer)
P Care (Precaution)
U Change Direction
D Definite Stop

OPERATION DESCRIBED IN TEXT IS WORKED OUT ABOVE. NOTE THAT IT IS NECESSARY ONLY TO ANALYZE MOTIONS, NOT TIME THEM.

WORK FACTOR ANALYSIS TAKES STOPWATCHES OUT OF TIME STUDY

Greater accuracy and speed, and no employee complaints about stopwatches, when time standards are set this way

TED C. STEWART • DEPARTMENT HEAD, METHODS AND STANDARDS DIVISION MOTOROLA, INC., CHICAGO

USUALLY you can tell a time study man by his stopwatch. This no longer is true in the Chicago radio plant of Motorola. Stopwatches have been outlawed, and in their place engineers make use of a method known as "work factor analysis."

This modern method of determining standard times for production operations and for estimating new jobs is paying off with handsome dividends. Less time is required to determine elemental operation times. More accuracy and consistency is being realized. Errors in establishing time values have been practically eliminated. And worker morale is way up.

Management made the decision to outlaw the use of stopwatches by standards engineers only after careful consideration. This was an important decision to make, because if anything went wrong it could throw off the entire cost structure and efficiency determination of the plant.

The first step was to call in an impartial group to check the standards then in force throughout the plant. The purpose was to give a "bench mark" with which the existing standards could be compared. A detailed and thorough examination of the work factors standards and the manner in which they were established showed their remarkable ac-

Distance Moved, Inches	Basic	Work Factors 1	2	3	4	Distance Moved, Inc
(A) Arm — *Measured at Knuckles*						
1	.0018	.0026	.0034	.0040	.0046	1
2	.0020	.0029	.0037	.0044	.0050	2
3	.0022	.0032	.0041	.0050	.0057	3
4	.0026	.0038	.0048	.0058	.0066	4
5	.0029	.0043	.0055	.0065	.0075	5
6	.0032	.0047	.0060	.0072	.0083	6
7	.0035	.0051	.0065	.0078	.0090	7
8	.0038	.0054	.0070	.0084	.0096	8
9	.0040	.0058	.0074	.0089	.0102	9
10	.0042	.0061	.0078	.00	.0107	10
11	.0044	.0063	.0081	.0	.0112	11
12	.0046	.0065	.0085	.0102	.0117	12
13	.0047	.0067	.0088	.0105	.0121	13
14	.0049	.0069	.0090	.0109	.0125	14
15	.0051	.0071	.0092	.0113	.0129	15
16	.0052	.0073	.0094	.011		

1 5

ors 4	Distance Moved, Inches	Basic	Work Factors 3 ×2×50%	3	4
	(F, H) Finger-Hand — *Measured at Finger Tip*		4 ×2×25%		
58 .0067	1	.0016	.0023	.0029	.0035 .0040
64 .0073	2	.0017	.0025	.0032	.0038 .0044
		.0019	.0028	.0036	.0042 .0049

2 3 4

THEN SELECT VALUES FROM THE WORK FACTOR TABLES OF STANDARD DATA

curacy and consistency. Some of the old standards were found to be "loose," others "tight."

It is almost impossible, save for the most rigidly trained and controlled groups of engineers, to maintain any reasonable degree of accuracy between different time study men. Even well-trained groups of engineers of different corporations in the same industry will be using different speed-rating bench marks.

These inconsistencies are impossible with this new method of analysis, the report indicated. After additional investigation, management decided to have this outside group train the standards engineers of the company on how to use and apply the new system.

This method of determining standard times, without the use of a stopwatch, is based upon hundreds of detailed stopwatch studies made of *basic* arm, leg, hand, and other body motions. All of these analyses were timed and speed-rated from actual production jobs. These findings were then reduced to a one-page "moving-time table," which is the basis for the entire system.

The table gives a time value for any single movement by any member of the body. Adjustments are made on the value determined corresponding to the control and degree thereof required in the movement. These various degrees of control are known as "work factors," and consist of the following: Weight or resistance to movement, definite stops required, definite directional controls, cautions or operational dangers, and changes of directions in movement.*

Any of the three types of analysis may be used in determining a rate without the use of a stopwatch. The type to use is wholly dependent on the work class, and the degree of skill of the engineer or student engineer using it. The three types are detailed analysis, simplified analysis, and standard analysis.

Detailed analysis. This type of analysis requires a motion-by-motion consideration of everything that must be within an operation to perform it properly. Take the "pick-up" of a simple bolt from a bin to illustrate how this type is used.

First would be the movement of "transport empty to bin." This is an arm movement of, say, 14 inches. The motion preceding the definite obtaining of control of the one bolt from many would require the factor of "definite stop."

The "grasp bolt" analyses are based upon high-speed, micro-motion pictures taken of various operators' fingers grasping many different parts. After becoming familiar with the original pictures upon which the "grasp" elements are based, the analysis is fast and simple. In this case, there are three elements:

1. The "grasp" of the part. This is a finger motion of less than an inch, so no factor is involved.

2. The "re-grasp" of the part. This is expressed in percentage of occurrence. The percentage is based on comparison with the actual occurrences in the motion pictures (two finger motions involved here—opening and reclosing the fingers to gain control of a part after slippage).

3. The "separate" of the parts grasped, if no more than one is grasped. This is again expressed as a percentage, and is based upon the motion picture studies. This occurrence consists of two small finger motions: One to permit the not-wanted part or parts to slip from the fingers, and the other to regain control of the desired part.

The final step is to "transport loaded" to the nut held in the other hand. This, another arm motion, requires two factors—"direct control" and "definite stop." These factors compensate properly for the relatively slow last two inches or so

*For a more complete description, including the unabridged tables, see "Motion-Time Standards," Plant Operation Library No. 96, FACTORY, May, 1945.

of the transport to nut, immediately prior to the assembly.

It now remains only to record the completed analysis for the "pick-up bolt." In recording the motion analysis, the body member is indicated first; the distance moved, second; and the work factors, third. The figures determined for this movement are circled on the illustration shown on page 127. The completed analysis is shown in the accompanying table.

Simplified analysis. This type of analysis is a simplified value determined from a rough-off derivation of the detailed values. Careful examination of the "detailed values" showed definite grouping of the various values. The result is that many elements have been placed in special categories and then compiled in book form for estimating purposes. Now, with a simple estimate of the distance reached and the difficulty of the actual grasp, it is possible to determine quickly the appropriate value from the "simplified tables."

This method can be applied to any and all types of elements. However, it should be used only by engineers thoroughly familiar with the principles of the detailed analysis. An experienced engineer can establish the elemental values for a long cycle job and determine the actual rate within 15 or 20 minutes of his first sight of the job. Before, this could have required hours to determine the correct time allowance.

The standard resulting from a "simplified analysis" can be depended upon to stay within 3 to 5 per cent of a "detailed analysis," "work-factor standard data evaluation," or an expert speed-rating time study of the same job.

Standard analysis *(from work factor data)*. Tables of standard data have been compiled from the "detailed analysis" on many common work operations, such as wiring, soldering, and riveting. Standard data on operations of this type are particularly valuable in the radio industry, so they received priority in development of data tables.

The reaction to the installation of this standards system from top management, production supervisors, and workers has been good. With this form of analysis it is possible to allot a precise number of work elements to each worker. Consequently, no operator is "overloaded" or "understood"; this is particularly valuable in establishing balanced work cycles on assembly lines. It is easier for everyone to understand; the result is better cooperation between time study and supervision.

Job Set in Ten Minutes

The various tables were compiled by the department with all data and rate information (actually the permanent file study sheet) combined on one form. The various values are then merely circled, added, and converted into the rate to be released for the job. An engineer can actually set a rate on a job in ten minutes or less using this pre-rate sheet. Its accuracy, flexibility, and speed also permit it to be used for cost estimating.

THE AMERICAN WAY

IF we consider the ultimate result of this tendency to stretch collective bargaining to comprehend any subject that a union leader may desire to bargain on, we come out with the union leaders really running the economy of the country; but with no legal or public responsibility and with no private employment except as they may permit.

Under these conditions, the freedom of management to function properly without interference in making its everyday decisions will be gradually restricted. The union leaders—particularly where they have industry-wide power—will have the deciding voice in all managerial decisions, or at least will exercise a veto power that will stop progress.

Competition will be stifled and progress in the improvement of industrial processes which reduce the cost and price of the goods produced by industry will be halted.

Only by defining and restricting collective bargaining to its proper sphere can we hope to save what we have come to know as our American system and keep it from evolving into an alien form, imported from east of the Rhine. Until this is done, the border area of collective bargaining will be a constant battleground between employers and unions, as the unions continuously attempt to press the boundary farther and farther into the area of managerial functions.

The law will be principally responsible for this continuing conflict. As long as the law is not clear on this issue the unions will feel that they are justified in their efforts to drive ahead in this direction. On the other hand, employers will be equally determined to resist these efforts to restrict management's functions at the expense of progress.

Charles E. Wilson, President,
General Motors Corporation

LOOKING AHEAD IN LABOR

Last-minute round-up as we go to press

A stabilizing factor long missing from the bargaining table is back with us. It's creeping up on many labor leaders. To left-wing outfits it's a nightmare.

This element is the fear of losing a strike. Call it strike risk. We haven't had it since the War Labor Board took over during the war

In those days, leading labor was a snap. You took what management or WLB gave. If you struck, WLB bailed you out, then decided your dispute.

Today it's different. Unions can lose strikes. They *are* losing strikes. An unwary union leader can fall on his face. John L. Lewis is no exception. After four weeks of strike, he settles for a pension less favorable than he could have got without striking. And without Judge Goldsborough's whopping big fines.

In New York the CIO's strike against overseas cable companies ends after three months. The strikers lose their contract, get no wage increase.

At four Precision Castings Company plants, strikes are broken by rival unions.

At Nashville Corporation, Philip Murray's tough steel workers take it on the chin from the machinists. *A 15-week strike is lost.*

Across the country, CIO packinghouse workers lose a gamble when President Truman doesn't enjoin their strike against the big four packers. Reason — *expected emergency didn't materialize.*

Two elements stand out in these lost strikes — stiffened management resistance to union demands; union failure to comply with Taft-Hartley non-Communist affidavit rule.

Pressure for ending NLRB boycott grows daily. Steel union must file non-Communist oaths. Otherwise Inland Steel need not bargain on pension plan. *So NLRB rules.*

Steel workers' victory against raiding by bricklayers doesn't protect them from patternmakers and machinists. They've scored significant coups against Murray.

●

Ultimately Murray will capitulate to Taft-Hartley. *It may come this month in Boston. Or in fall, after elections, if Supreme Court upholds lower court's approval of the affidavit requirement in the maritime union case.*

This move will put steel union on the side of AFL and friendly CIO unions—auto, textile, clothing, and shipyard. On other side of fence, Lewis and left-wing CIO unions.

Blame ERP for confusion within labor's house. It pulls CIO apart while drawing AFL and CIO closer together.

Support of Marshall Plan to stop Communism is major goal of AFL and national CIO. Already CIO's Political Action Committee backs away from threat to lick Congressmen solely on Taft-Hartley test. In AFL many leaders privately criticize Green's die-hard stand.

●

Opposition to ERP guides CIO left-wing backing of Henry Wallace. *ERP and Wallace issues have split CIO seriously between left and right. The battle rages furiously on picket lines, in plants, union halls, and the press.*

Left-wing CIO unions are vulnerable on more than one score. They can't use NLRB for protection. They oppose CIO policy. They can't sell pro-Communist stand to rank-and-file in light of international tension.

Consequently, ardent right-wing CIO unions have opened up on the left flank. And they get help from AFL. Leading the drive is Reuther's UAW. Targets: *electrical, farm equipment, transport, smelter workers.*

Leading retaliation is Communist *Daily Worker.* It has turned against Murray and Quill, paints Reuther blacker than management. Feelings run high. Reuther thinks Communists may have fired shotgun blast he got.

Even so, it's too early to predict a mass left-wing exit from CIO. Neither side wants it. Or plans it. Reasons exist on both sides for living together.

If complete break comes, it probably will be spurred by international developments, accompanied by AFL-CIO merger. Labor then would be split on left-right lines.

Already this is shaping up on world basis. AFL and CIO work closely together on ERP. Movement is on for new world federation of anti-Communist labor groups. It might pull CIO out of WFTU, leave WFTU to the commies.

Pessimistic. That's how labor leaders view election outlook. Wallace split assures Republican President and defeat of some liberal Congressmen. PAC's effectiveness is badly hurt by left-wing boycott. CIO talks of ignoring Truman, focusing fight on Congressional races.

Current plight stirs plans for a liberal, anti-Communist third party by '52. Reuther's on record for it.

Hearings this month on T-H changes. But don't look for any until next year. Rep. Landis of Indiana, who may head Labor Committee, polled his district on T-H. The vote: *To strengthen, 819; leave as is, 493; repeal, 564.*

LOOKING AHEAD IN BUSINESS

Last-minute round-up as we go to press

Overshadowing the business outlook is one fact: *This is Russia's year.*

This is the time for the Soviets to play big chips. The United States will be concentrating on electing and installing a new administration. It will take time before the European Recovery Program will begin to show positive results. Western Union for Europe can be no more than tentatively mocked up before next year.

Business decisions must be gaged by the Russians' power plays. U. S. moves to counter the Russians are reflected throughout the economy. Even talk of big defense or new controls on the economy can send prices shooting upward. Spectacular example: *Used car prices were marked up $100 across the board, and higher-priced cars even more, after President Truman's call to Congress for the draft, universal military training, and controls.*

Impact of new defense spending cannot be measured until Congress makes definite decisions—but it is clear that new defense orders must be piled on top of an economy going nearly full-tilt.

●

Booming business is virtually guaranteed through 1948. Tax cuts, only now going into effect, will chop $4.8 billion off the year's tax bill — but the saving comes almost entirely in the second half. That ups purchasing power by a rate of almost $10 billion in the last six months — and is enough in itself to insure rising sales curves.

On top of all this, a swing in money and credit is clearly coming. Where they have been tight, they will now be easy. Bankers' anti-inflationary loan policy was successful in first months of 1948 when the Treasury was siphoning off billions from the money supply in first-quarter tax collections. But lighter taxes, ERP spending, and rising price levels will open up the money market and result in easier credit.

All this adds up to another round on the inflation spiral. But wage and price increases won't be like the huge jumps of the last two years. U.S. Steel's precedent-setting check on wage increases and its cut in prices may limit the third round. But another coal strike and another wage increase to the miners in July — or other "major" wage advances — can offset attempts to hold the line.

Production has caught up with demand in many lines, still others will find themselves in normal markets before the year is out. Price increases in this round must be gaged against increasing buyer resistance.

Prospects of good crops, plus the growing tendency of housewives to cut down on spending for food, will prevent anything more than mild increases in food prices.

With this picture in mind, business leaders are advising Congress that they would rather take their chances in free markets.

A defense boom may force controls later. But business feels that setting controls into motion now, as insurance against rapid inflation, might build up resistance, might result in restricting production.

●

The labor market is tightening now, will take up practically everyone who can work this summer, but can be expected to ease slightly by year's end.

Personnel men are already enlisting high school and college workers for the summer as a hedge against increased orders generated by tax reduction, new military orders, and losses to the draft.

By December, however, even if the demand for jobs is as high as it was before Christmas last year, the total labor force will be larger by about 700,000. Even if the armed forces take an additional 300,000 men by that time, the increase in the labor force will make the labor market mildly competitive again. But, with more than "normal full employment" continuing, that won't mean a setback in business or wage cutting.

●

What's happening to productivity puzzles both management and union leaders. Economists looked for increases in output per worker on the order of 10 per cent a year each year for the first three post-war years. Recovering wartime losses in productivity and putting war-gained know-how, new materials, new machines, and new methods to work in big-volume production of civilian goods should increase efficiency dramatically, they thought.

And — if we had had anything like that kind of gain in productivity, inflation would be a minor worry. Gains in productivity would offset wage increases and break the wage-price spiral.

With no information from official sources on post-war productivity, both unions and management have been in the dark. Now a study made by National Association of Manufacturers sheds some light. Production per man-hour in ten leading industries is up some 5.3 per cent from 1939, NAM estimates.

But productivity gains on that order mean that we have not yet regained 1940-41 levels. And in the light of some $16 billion invested in new plant and equipment in the manufacturing industries since war's end, a gain of only 5 per cent poses a major question for management.

What can be done to push sagging efficiency up again?

TESTS ARE CONDUCTED in a well-lighted, quiet room. Workers are given written tests, as well as pegboard and assembly board tests to ascertain their manual dexterity

EMPLOYEE TESTS BRING LOWER TURNOVER

GEORGE H. TURNER • PERSONNEL DIRECTOR, VICTOR ADDING MACHINE COMPANY, CHICAGO

A "YARDSTICK" program to measure both the mental and mechanical fitness and ability of present and prospective employees is paying real dividends at Victor.

Turnover is reduced because people are placed in positions best suited to their likes and aptitudes. This, in turn, tends to bring about a natural increase in the quality of the entire working force. Additionally, management is provided with a gage for future promotions. An employee reacts favorably to the knowledge that his ability not only will not, but cannot, be overlooked when better jobs open up.

When the company first became interested in the possibility of a testing program back in 1944, an experiment was decided upon to convince the management—and, more important, the employees—of the validity of the test to be used. The first step was to give the applicable test to top management, and then to general foremen, superintendents, and their equivalent in the offices. Next, authorization was obtained to try testing workers in various production departments. Supervisors were asked to select the men who, in their opinion, were the ten best in the department. They also selected ten employees whom they rated as average. The personnel department, which conducted the test, was not notified of the group in which the individual employees were classified.

Employees were then given a battery of tests which included not only those of a general nature, but also those relating to specific vocational skills. The results of these tests were scored and grouped. Then the results were checked against the foremen's ratings. This comparison showed that in about 95 per cent of the cases, the appraisals and the test coincided.

Word of these results spread like wildfire through the organization.

Instead of the personnel department requesting that employees be tested, the foremen began to demand application of the program to their department. And almost immediately there developed a reluctance on the part of the foremen to accept any new employee, unless he had been given the necessary test to determine his fitness for the job.

Tests vary by job type and individual requirements. Consequently, a battery of several general tests and one or more specialized tests are usually given. It has been found desirable to administer not only the single special test having the greatest direct bearing on the job in question, but also any test relating to "allied vocations," and to any other special qualifications an applicant might have.

It was found that employees should not be required to spend too much time on the test at any one sitting. The policy at Victor is to limit the time to a maximum of two hours in any one day. Where it is necessary to exceed this limit, tests are spread over several days.

The following are some of the tests given at Victor, together with a brief description of the factor or factors they are used to measure:

1. General adaptability. Rate of speed with which a person learns.
2. Kuder preference. Classifies interests into nine general families of occupation.
3. Bernreuter personality.
4. Machinist test. Job knowledge for machinists and toolmakers.
5. How to read a blueprint.
6. How to read a scale.
7. How to read a micrometer.
8. Clerical test. Speed and accuracy on clerical operations.
9. Mechanical adaptability. *Present* mechanical ability.
10. Mechanical comprehension. *Potential* mechanical ability.
11. How to supervise. Judgment in handling other people.
12. Blackstone stenographic. Nine elements of stenography.
13. Northwestern University vocabulary test.
14. Minnesota clerical test. Handling names and numbers.

PLANT MAINTENANCE DEPARTMENT
CONTEST SCORING

MEASURE	POINTS
1. Housekeeping	10
2. Safety	10
3. New ideas	10
4. Costs	10
5. Projects and other work	10
TOTAL	50

1. Housekeeping. A committee consisting of the superintendent, production manager, personnel director, and traffic manager will review each department frequently during the month and rate the department for housekeeping. Cleanliness of floor, location of material in its proper place, careful storage, maintenance of machinery, appearance of workers will be observed and the rating based on the observation. During the tour, each member of the committee will credit his own grade to the department and an arithmetical average of all ratings will determine the point allowance.

2. Safety. If the entire month is passed without a lost-time accident, the full credit of 10 points will be awarded. For each lost-time accident, 2 points will be deducted from the allowable 10. For each accident requiring medical attention, 1 point will be deducted from the allowable 10.

(Because of the number of employees represented in plant maintenance, and further because of the hazardous operations, for each consecutive month without a lost-time accident an additional ½ point will be added to the total.)

3. New ideas. A major suggestion involving a saving of more than $500 per year will be given the full credit of 10 points. Other acceptable suggestions will be graded in proportion to their importance or savings. For instance, a saving of $100 — 2 points; $200 — 4 points, etc. Considering a minor suggestion where savings cannot be estimated, 2 points will be allowed.

4. Costs. If the overhead budget figure is met or bettered, 10 full points will be allowed. For each $500 or fraction under budget, one point will be added.

5. Projects and other work. The great bulk of the plant maintenance department work is the completion of projects and other major jobs assigned by the management. If all projects are completed on time and within the budget, the full 10 credits will be allowed. If all projects are not completed on time or within the budget, the proportion of the overtime and the amount over budget will determine the points to be deducted.

EACH DEPARTMENT HAS A TAILORED-TO-MEASURE SET OF RULES. MAINTENANCE IS TYPICAL OF "INDIRECT" DEPARTMENTS. . .

FOREMEN'S CONTEST KEEPS

Foremen compete in direct and indirect departments for annual awards based on performance in 5 to 8 fields—and company reaps benefits of better supervisors, lower costs

JOSEPH W. KUEBLER • PLANT SUPERINTENDENT, DIXIE CUP COMPANY EASTON, PA.

How to insure proper application of important principles covered during monthly foremen's meetings? Dixie Cup Company's Easton plant faced up to the problem with an annual contest for foremen.

The contest is based on eight management subjects—housekeeping, safety, new ideas, customer complaints, turnover control, waste, production, and costs. Each contest runs from February through October. During those months 40 foremen from 14 departments are rated. Ratings are based on standards publicized at the start of the contest.

Awards are made at the annual foremen's Christmas party. Large-denomination savings bonds are given to those having the highest ratings for the 9-month period.

Actually, the contest is run in two divisions. One for direct manufacturing departments; one for major indirect departments.

The exhibits—one for a direct, the other for an indirect department—show how the rating is done. Scoring factors have been modified to fit conditions. Some points of the contest are scored monthly; others at the contest's end.

To tie the contest right down to

LID DEPARTMENT
CONTEST SCORING

MEASURE	POINTS
1. Housekeeping	10
2. Safety	10
3. New ideas	10
4. Customer complaints	10
5. Turnover control	5
6. Waste	15
7. Production	10
8a. Overhead	15
8b. Labor and material	15
TOTAL	100

1. Housekeeping. Same as maintenance department.

2. Safety. Same as maintenance department.

3. New ideas. Same as maintenance department.

4. Customer complaints. For each complaint received from customers involving lid production, 1 point deducted (exclusive of training defects).

5. Turnover control. If the department is below plant average, full credit allowed. If above, 1 point deducted for each point above average. (Uncontrollable losses not included.)

6. Waste. If the department's average for the previous month is lowered, 7.5 points will be allowed. In addition, 7.5 points awarded if percentage for same month of previous year is bettered. For each increase of 0.5 per cent or fraction thereof above figure of previous month or same month of previous year, 1 point deducted. (Waste control figures used.)

7. Production. If the planning estimates are met, 10 points will be allowed. For each 1 million or fraction below, 1 point deducted. (Allowance will be made for planning department changes.)

8a. Overhead costs. If below budget figure, 15 points will be granted. For each cent of controllable expense over budget, 1 point deducted; but for each cent under budget, 1 point credited.

8b. Labor and material costs. Production per labor hours will be used in determining labor and material costs as set up in the labor distribution sheet. If production per hour equals or betters the previous month, 7.5 points will be awarded. If production equals or betters the same month of the previous year, an additional 7.5 points will be allowed. For each 5 per cent decrease from the figures of the previous month or same month of the previous year, 1 point deducted.

. . .LID PRODUCTION IS TYPICAL OF "DIRECT" DEPARTMENTS (FOR SCORING PURPOSES) IN ANNUAL FOREMEN'S CONTEST

COSTS WITHIN THE BUDGET

daily operation, foremen receive reports on each of the contest points during each monthly meeting. Problems are brought to the front by foremen who seek their solution. Members of top management attend the meetings to give operational reports and to tackle common problems with the foremen. At the end of each meeting, foremen have an excellent picture of the company's current operating condition.

So that nothing will be left to memory, minutes of each meeting are given to foremen and members of top management. These minutes are complete, but brief, and give monthly and cumulative contest scores for all departments.

Results are gratifying. For example, costs for 1946 were 1.62 per cent *under* budget figures, against the 1945 standing of 0.15 per cent *over* budget figures.

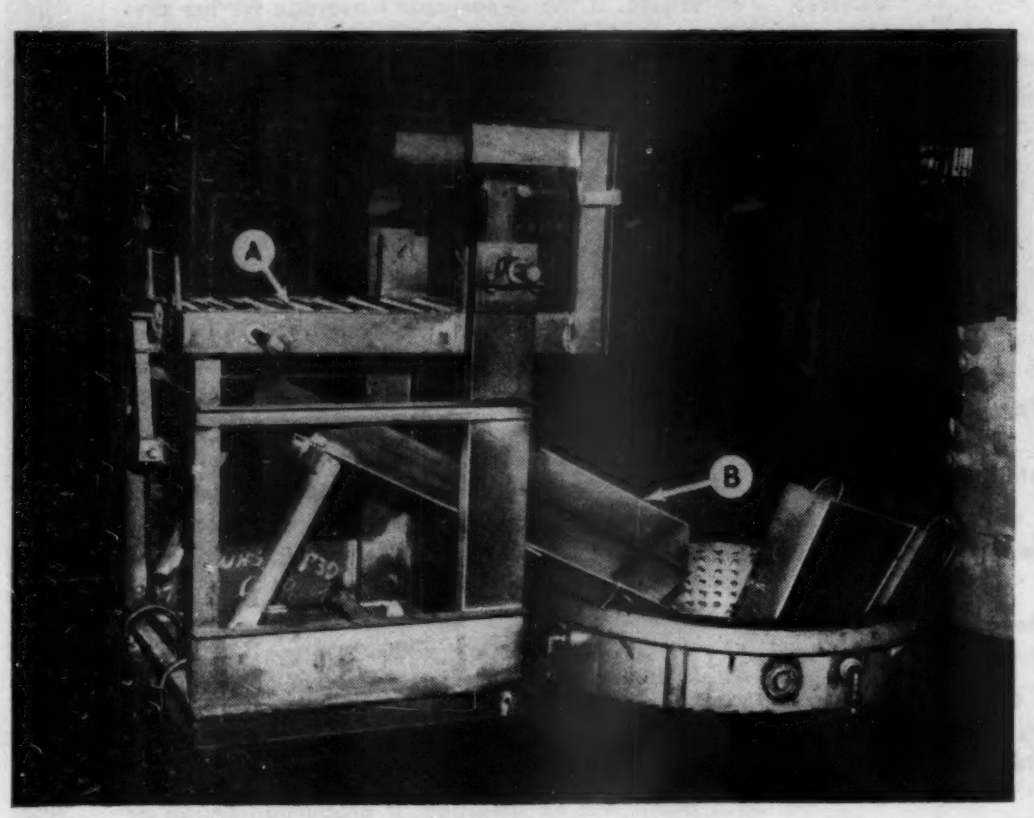
As regards housekeeping, scores improve monthly. The safety record for 1946 was directly attributable to the contest. Accidents for the year numbered 103 as against 135 in 1945. Days lost were 138 in 1946 compared with 304 in 1945.

Nine suggestions by foremen involving major machine changes netted savings of over $7000. This is in sharp contrast to a maximum of one or two noteworthy suggestions made in pre-contest years. A waste control program has been particularly effective. Reduction of waste has correspondingly reduced cost on cone-shaped Dixie and Vortex cups, for instance, by 22.5 per cent; on single-ply flat-bottom Dixie cups, by 3 per cent.

Foremen now come to meetings well prepared for intelligent discussion. They also feel they have a personal stake in management efficiency. Departmental morale has shown a corresponding increase.

OPERATING SHORTS

Readers are invited to contribute brief articles, illustrated when possible, reporting out-of-the-ordinary operating accomplishments. Accepted articles will be paid for.



RACK SAVES TIME, MINIMIZES HAZARDS

Dumping rack in heat-treat department at Mechanics Universal Joint Division, Borg-Warner Corporation, Rockford, Ill., makes job safer and easier. Container full of parts from hardening furnace is lifted on upper section of roller conveyor *A*. Angle iron section above holds container in position while parts are dumped. Operator merely tips fixture through 180 degree arc and parts fall onto chute *B*. Center of gravity was planned at pivot section of fixture to minimize the effort required of worker. From chute, parts fall into oil bath for quenching. Job is easier than using hoist and hand tip methods. It is safer for the worker. And less time is required.

VISITORS to Lehigh Structural Steel Company plant at Allentown, Pa., are offered a bowl of fruit "to keep the doctor away—while you wait" according to the sign on the table. Officials feel that this friendly gesture goes far in making visitors to the plant feel at home

BOOKLET TELLS NEW WORKER ALL ABOUT THE PLANT

Informality and many photographs characterize "The Story of Elesco Joe," a booklet given to every new employee of The Superheater Company, East Chicago, Ill.

"Elesco Joe" is a small drawn-in figure who makes a complete tour of the plant. He is shown first signing up with the personnel manager—then he starts on his way through the engineering department, the production department, the bolt shop, the header shop, and so on. He sees completed products and the parts that go into them. He doesn't miss even the laboratory, first aid, or timekeeping.

The first three pages of the booklet are devoted to a message of welcome to the company by the president, complete with his photograph. The last several pages explain policies, enumerate rules, describe employee services. On the inside front cover is a list of the products made; the inside back cover names the officers of the company. The center spread is an aerial view of the plant, keyed to show every department.

●

TIME IS SAVED for workers and cashiers at Sturtevant Division, Westinghouse Electric Corporation, Hyde Park, Mass., by the coin changing machine in the reception room. It is estimated that 25 to 50 calls at the cashier's cage are saved daily. Handy to the pay telephone booth, and candy and cigarette vending machines, the coin changer is loaded once a day with a fresh supply of nickels for employees and visitors. Nickels are delivered at standard U. S. Mint rates—five for a quarter, two for a dime

●

COMPANY INFORMATION IS EASY TO TAKE THIS WAY

"Know Your Company," says the back cover of *Better Living*, employee magazine published by E. I. duPont de Nemours. Then follow eight photographs with questions in the best quiz style. For instance, in the January-February, 1948, issue, the first picture is of a blond girl in a bathtub, scrubbing her back with a brush.

The caption reads "The pretty lady in this bathtub uses a brush with .... handle and .... bristles. (a) Nylon—nylon; (b) polythene—nylon; (c) Lucite acrylic resin—nylon; (d) nylon neoprene. (The answer is (c).)

Another picture shows a young man at a machine. The caption reads "Arthur Bennett, cord twist operator on 'Cordura' rayon yarn at Spruance

Works, is working in one of the more than . . . new types of jobs created in Du Pont since 1927. (a) 300; (b) 500; (c) 50; (d) 100.

Answers are printed, upside down, in the lower right hand corner of the page. In many instances they carry an additional message. For example, the answer to the question above is "(b) More than 500 new types of jobs, representing nearly 30,000 people."

Thus, in one of the most easily assimilated forms, information about the company, its policies, and its products, is presented to workers throughout the plants.

●

HELPER ON ELEVATOR SAVES MANY MAN-HOURS

RICHARD DILWORTH, Pawtucket, R. I.

It used to be that we had one man whose sole job was to run the elevator. Trucks of material to be transferred from one floor to another were brought to the elevator by men from the various departments, and taken to their destination by these same men. Plenty of time was lost waiting for the elevator; more time was lost by the men getting out of their own departments, away from their own supervisors.

Now the elevator operator has an assistant. His job is to cover all the floors in the building, move materials from machines to the elevator door, and load and unload the trucks into and from the elevator. There is no more crowding of the elevator, operators spend their time on productive work instead of riding up and down, and a definite safety hazard has been eliminated.

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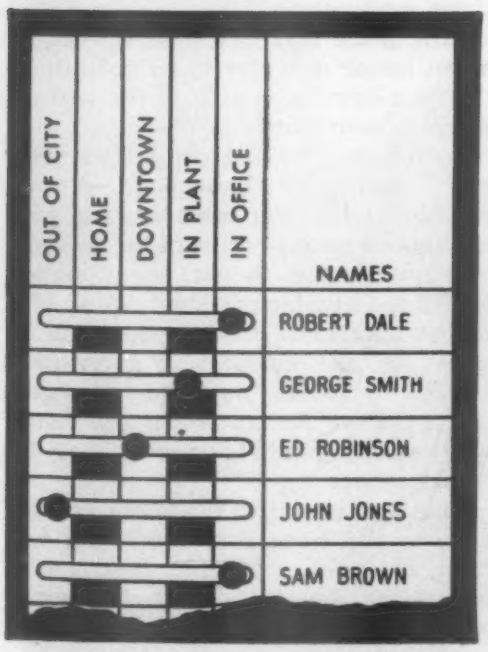

PEGBOARD TELLS WHERE EXECUTIVES CAN BE FOUND

A two-sided pegboard located at the combined information desk and telephone switchboard at Cavalier Corporation, Chattanooga, Tenn., tells the receptionist-operator where to find key executives. This board supplements the regular plant paging system in that it eliminates delay and lost time while searching for men when they are not available.

As shown in the accompanying sketch of the layout of the board, the operator knows at a glance whether a person wanted is in the office or plant, or away from the plant, such as down town, at home, or out of the city. Each person listed has a movable stud which slides in the slot opposite his name. The stud is moved to the proper place whenever the person leaves or returns to the office.

As a further refinement, the operator places a red marker on the stud whenever a message has been taken for the absent person. This marker indicates that the message can be found in a compartment provided for that purpose. The marker is removed when the message has been picked up.

●

HUMOROUS VERSE WARNS AGAINST ACCIDENTS

Cartoons and verse bring home the safety story in an accident-prevention booklet recently issued to workers in the industrial products division of the B. F. Goodrich Company, Akron. Characteristic is the following:

"The worker who gets hot caresses
By backing against the curing presses,
Had better then prepare in advance,
By always wearing asbestos pants."

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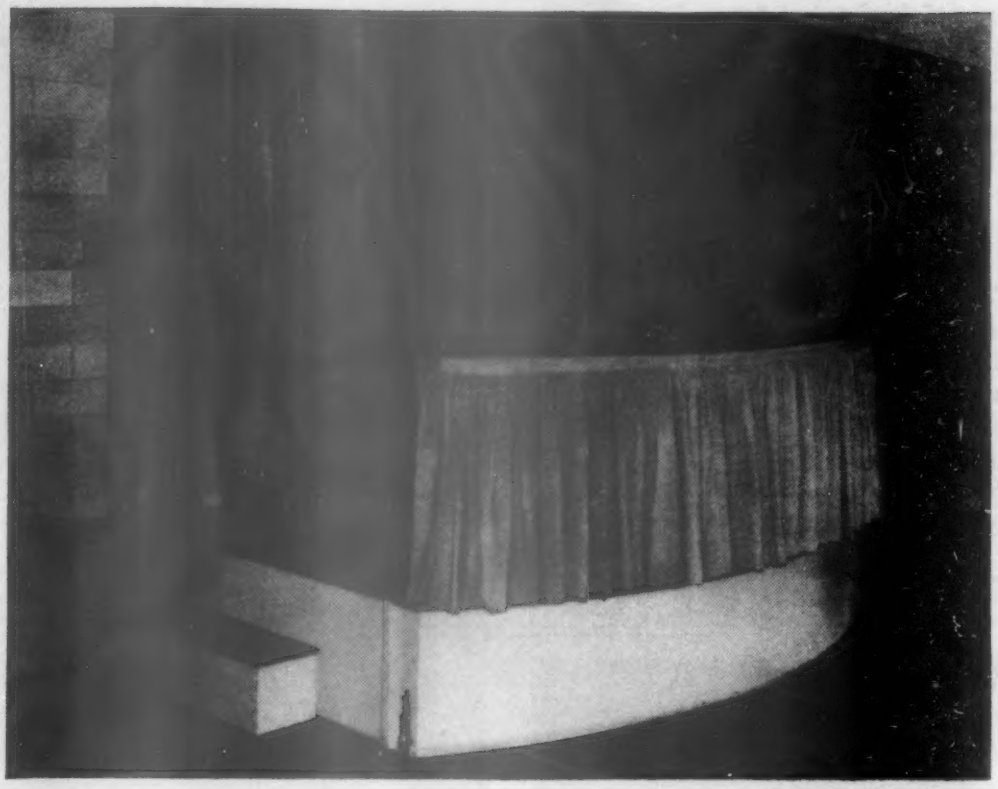

RETRACTABLE STAGE platform in plant cafeteria of the Industrial Tape Corporation, New Brunswick, N. J., saves room when not being used for special entertainment, official talks to employees, or supervisors' meetings. View shows platform rolled out from recess in wall and held in place by a plunger-type door stop on each front side. Before retraction, removable steps are unhooked from simple slotted fixtures and stored on platform behind the rail curtain. In retracted position the rail is pushed flush to wall. Rear wall curtains add to stage appearance and remains undisturbed

POSED PICTURES POINT UP SAFETY STORY

ROBERT H. ALBISSER, Safety Director, Merck & Sons, Inc., Rahway, N. J.

The safety department at Merck places great reliance upon a safety photograph feature in each issue of *The Merck Review*, the employees' magazine.

After experimenting with several techniques for presenting the safety messages, it was found that the so-called *do-and-don't* method is the most effective. *Don't's* are illustrated, but the emphasis is on *do's.*

In selecting a theme for the lessons, the safety department always chooses an operation that is performed frequently by a large number of workers. And the models are equally carefully chosen.

Three factors govern the selection of models:

1. They must be pictured in character. For instance, a factory operator takes a factory operator's role.

2. They must be dressed neatly, thus setting a good example.

3. They must not have posed before. This practice gives more employees a chance to get their pictures in the magazine, and enables more readers to

say, "I know that fellow," when they see the shots.

Pictures are set up the safety department and public relations, and a *Merck Review* staff photographer takes the photographs.

•

"Be a Square Shooter, not a Rumor Ralph," says the *Balco News*, published for employees of Bausch & Lomb Optical Company, Rochester, N. Y. Rumor Ralphs are described as those who start rumors, and those who carry them on. Square Shooters find out if a story is true, before they pass it along.

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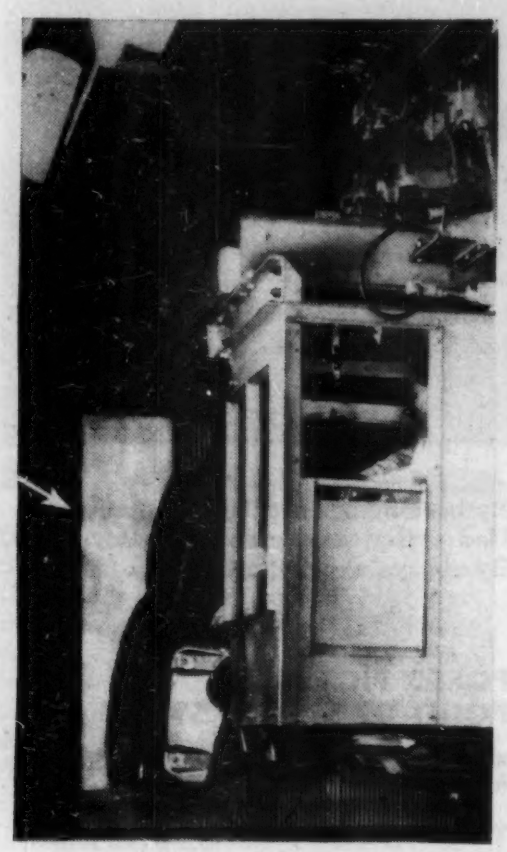


FELT PADS PREVENT DAMAGE TO CAR BODIES

Car bodies no longer get banged about as they are lifted from trailer trucks by overhead cab hoist for delivery to the wiring line at Packard Motor Car Company, Detroit. The bodies are lifted up and through a wall of the plant.

Formerly, because of the swinging and swaying of the bodies, they were likely to hit the side of the wall as they were being brought through. Sometimes they were scratched—a damage that could easily be repaired. Other times the damage was more severe, necessitating bumping and repainting.

Now all this is eliminated. Felt pads mounted on wall edges (arrow), are shaped to the contour of the body. Thus it no longer hits the wall, and the felt pads polish rather than damage the finish. Repair costs are eliminated, and production hold-ups no longer occur.

MERIT CERTIFICATES ENCOURAGE MORE OUTPUT

A non-monetary incentive plan has cut direct labor cost 15 per cent at the Dixie Cup Company's Easton, Pa., plant.

Based on production-machine running speeds determined by the standards department, the plan covers some 500 production workers. When a machine operator reaches 95 per cent efficiency for one day, she becomes an "honor" operator. On this occasion, the plant superintendent writes her a congratulatory letter. A "Certificate of Merit" either accompaines the letter or is given the employee by her foreman or a member of top management.

As a continuing program, the efficiency score of each honor operator is posted monthly on departmental bulletin boards. This helps maintain the competitive, productive spirit. Before long, almost everyone in each department is on the honor list. Letters of praise to departments are another means of keeping group morale high.

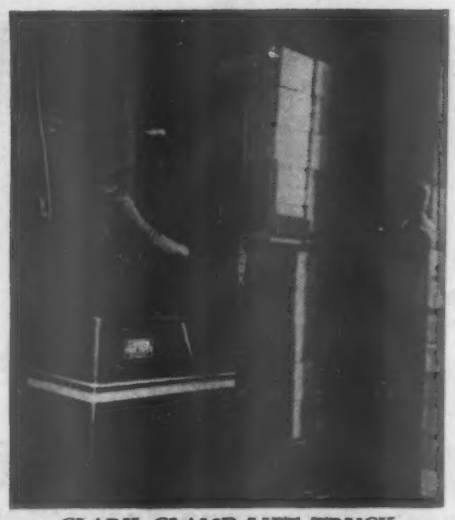
When an operator drops below the predetermined efficiency level for a month, a letter is sent commending her for previous excellent performance and asking whether management can help her regain her former high efficiency level. A typical letter says, "Recently, in checking over the vortex department chart, it was noted that you had registered eight honor days in December whereas this month thus far you have been credited with only one.

"Since you had such an excellent performance in December, we are wondering why there should be a decrease in production during this month. It is realized, of course, that starting with the first of the year the department was confronted with operating difficulties which hampered production. Every effort is now being made to correct these conditions.

"The mere fact that you are listed as an honor operator is an indication that you have been able in the past to perform your duties in the vortex department very satisfactorily. Undoubtedly, with your knowledge of the machines which you are operating, you can inform us as to some of the reasons why production is not being maintained at a satisfactory level. We would indeed appreciate it if you would do so either by the medium of suggestion blanks, by jotting down any thought you have on the bottom of this note, or by an expression to your foreman or to the writer."

This note is sent to the honor operators, in the hope that correction for some basic fault that has been overlooked will be suggested by the girls who are actually operating the machines.

The net result of this program has been a substantial saving in direct labor costs, reduced turnover, improved morale, increased group competitive spirit, and the return of individual pride in accomplishment.



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management data 28 sheet

PRODUCTION CONTROL FUNDAMENTALS

1. Purpose of Production Control

a. Production control is a tool of management used to schedule the manufacture of products on the basis of existing facilities, and to take action to insure maintenance of the schedule.

2. Fields of Application

a. In theory, production control is essential in all industrial enterprises.

b. In practice, the value of production control increases with the number of different sales orders, products, processes, and operations.

c. Here a typical production control plan is described as it applies to the manufacture of mechanical and electrical products, involving detail parts and assemblies.

3. Sales Requirements

a. The first step in a sound production control plan includes consideration of the sales program.

b. The sales department provides the production control department with the following information: (1) All sales orders received; (2) a rough forecast of future sales by months, beyond the actual orders received, for a total period of at least 12 months.

c. The sales forecast permits over-all planning of the manufacturing organization, equipment requirements, material purchases, and working schedules.

4. Product Engineering Requirements

a. The product engineering department provides the production control department with (1) parts lists for all products, itemizing all detail parts and assemblies; (2) product drawings for all products, including a drawing for each detail part and assembly; (3) bills of materials for all products, specifying the type and quantity of material for each detail part; (4) an adequate numbering system to identify the product drawings for all products, detail parts, and assemblies.

b. The above information provides essential details for the production control plan.

5. Process Engineering Requirements

a. The process engineering department provides the production control department with operations to be performed, the departments where the operations will occur, the machine tools or equipment to be used, the tools, jigs, fixtures, and gages to be used, as well as the estimated time to set up the operation, the estimated time per hundred pieces to perform the operation, and the labor grade of the employees involved in each operation.

b. Operation sheets are intended to establish and control the method and cost of manufacturing the products.

6. Manufacturing Program

a. On the basis of information received from the sales, product engineering, and process engineering departments, the production control department is in a position to develop a manufacturing program.

b. On the basis of existing manufacturing facilities, calculations are made to indicate the approximate volume of products that can be machined and assembled over a period of two months.

c. In the development of the above calculations, analysis of the operations specified on the operation sheets will also indicate the degree of subcontracting required for detail parts or assemblies for which manufacturing facilities have not been provided.

d. Sales orders representing products to be machined and assembled beyond the next two months are placed in an inactive file.

f. Each month, sales orders representing one month of manufacturing are transferred from the inactive to the active file.

g. Consideration should be given to the inactive file of sales orders, as well as the rough forecast of future sales by months, to recommend the expansion or contraction of existing manufacturing facilities and working schedules.

7. Reproducible Master Sheet

a. Prepare a reproducible master sheet for

Prepared by Bruno A. Moski, Jr., Plant Manager, The American Paper Goods Company, Kensington, Conn.

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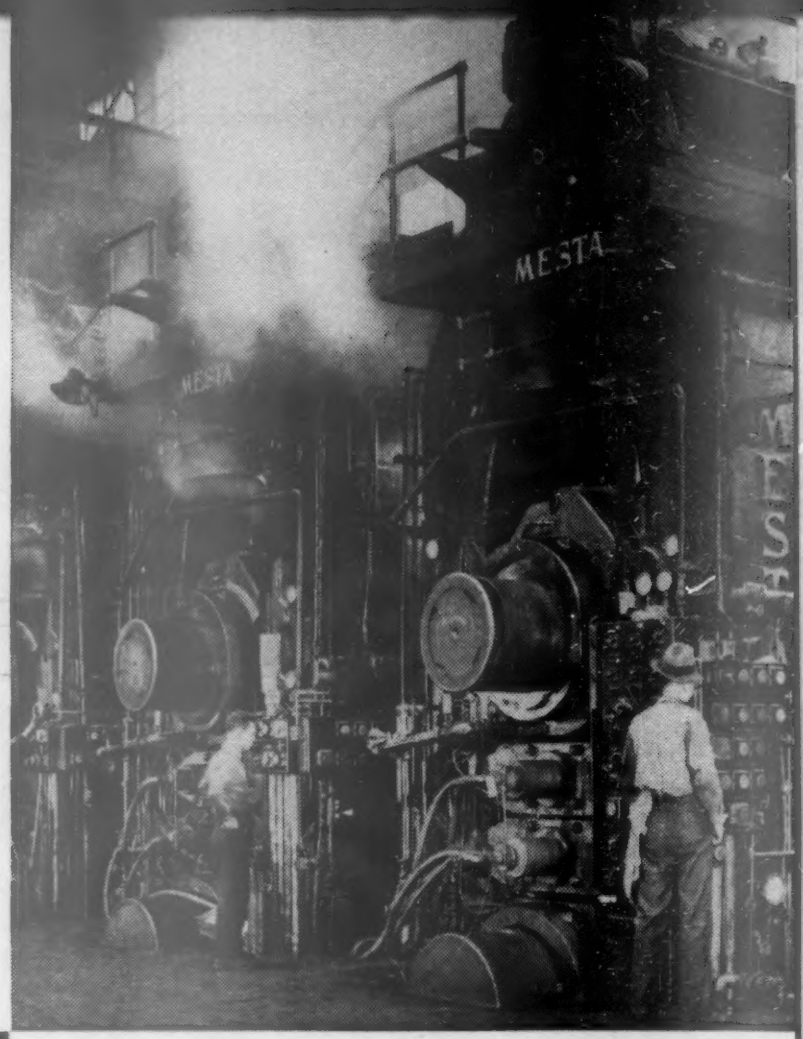

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